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HIGHWAY ADMINISTRATION AND FINANCE

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HIGHWAY ADMINISTRATION AND FINANCE

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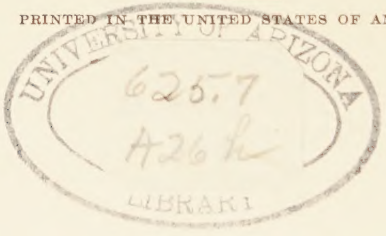

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PREFACE

Highway Administration and Finance was written as a text and reference book on the management and economic phases of highway engineering. These constitute an increasingly important and exacting part of the procedure incident to the development of modern highway systems.

A state or a municipal highway department is called upon to exercise three distinct types of administrative functions. One is to aid in securing legislative enactments that will afford an adequate legal basis for the work of the highway department, another is to assist in creating a sound financial system to meet the cost of highway improvement, the third, and most exacting, is to organize and supervise the activities of the staff engaged in the construction and maintenance of roads and pavements.

The material presented herein is intended to serve as a basis for the study of these three phases of highway administration. It is contemplated that considerable collateral reading will accompany the use of the text and accordingly numerous references are inserted throughout the book. Those who wish to do no more than acquire a general knowledge of the subject will find the text itself sufficiently complete for that purpose.

While this treatise is to a considerable extent a compilation of the literature of the subject, the authors have not hesitated to interject many observations based on their experience in their respective fields and continuous contacts with highway administration over a period of many years.

At Ames, the subject matter of this treatise is the basis for two courses, each of three quarter credits, the one being on highway jurisprudence and finance, and the other on highway department organization and construction management. It is quite possible by limiting the amount of supplementary reading to cover the entire book in a course of three semester credits.

A substantial amount of historical data for representative states has been included, for the reason that in no other way can the reader obtain clear ideas regarding the nature of town, town-

61099

ship, and county organization as the same relate to the concrete problems of highway administration and finance.

The authors are under special obligation to those whose articles on various subjects are included as a part of the text, and to Thomas H. MacDonald, Chief of the United States Bureau of Public Roads, for his sympathetic cooperation and permission to make use of valuable data compiled under the auspices of his Bureau. Indeed, save for the excellent economic studies and general technical reports published in recent years by the Bureau of Public Roads, the American Association of State Highway Officials, the State Highway Commissions, and certain Municipal Public Works Departments, a book of this nature in the field of highway administration and finance could scarcely have been written.

THE AUTHORS.

AMES, IOWA,
December, 1926.

CONTENTS

PAGE

PREFACE v

CHAPTER I

HISTORY OF NATIONAL HIGHWAY ADMINISTRATION 1
The Constitution—Ideas of President Washington—The Cumberland Road—The Road Fund—Specifications—Tolls—Constitutionality—Madison Veto—Monroe Veto—Jackson Veto—Politics—Cumberland Road Abandoned—Influence of Railroad Building—Other National Highways—Land Grants—Local Control—Bureau of Public Roads.

CHAPTER II

HISTORY OF STATE AND LOCAL HIGHWAY ADMINISTRATION 28
Pioneer Spirit—Types of Local Government—Early Road Laws—Cumberland Gap—Wilderness Road—Progress of Iowa—Illinois—Massachusetts—Early State Aid Laws—Unequal Taxation—New Jersey—Vermont—New York—Forms of State Aid—State and Local Finance—County and Township Organization—Local Government Influences—Political Balance.

CHAPTER III

THE DEVELOPMENT OF HIGHWAY ADMINISTRATION 51
Legislative Trends—Status of Existing Administrative Systems—Bureaucracy—Township Administration—County Administration—State Highway Departments—Functions of State Highway Departments—Administrative Problems—Efficiency—Continuity of Policy—Theory of Organization—Ideal System—Types of Organization—Federal Aid Highways—State Highways—State Aid Highways—Bureau of Public Roads.

CHAPTER IV

THE DEVELOPMENT OF HIGHWAY SYSTEMS 74
Origin of Township Administration—Origin of County Administration—Toll Roads—National Roads—Rise of Modern Highway Systems—State Road Systems—Key Cities and Towns—National Roads of 1926—Selection of Road Systems—Improvement of Road Systems—Highways of the Future.

CHAPTER V

HIGHWAY SYSTEMS OUTSIDE THE UNITED STATES 88
Canada—England—France—Norway—Denmark—Switzerland—Czechoslovakia—China.

CHAPTER VI

PAGE

PRINCIPLES OF HIGHWAY FINANCE 108

Nature of Public Finance—Classification of Public Revenue—Revenue from the Public Domain—From Public Industries—Fees—Special Assessments—Miscellaneous Revenue—Property Taxes—Income Taxes—Inheritance Taxes—Poll Tax—Bonds—Motor Vehicle Taxes—Statistical Data.

CHAPTER VII

FEDERAL AID 133

Federal Act of 1912—Recommendations of Secretary Houston—National Forest Roads—Report of Congressional Joint Committee—Apportionment—Progress in Construction—Benefits—Act of 1919—National Highway Commission—Administrative Regulations—Forest Road Projects—Classification—Act of 1921—Maintenance—Research—Benefits of Federal Aid—United States Highways—System of Forest Roads—Statistical Data.

CHAPTER VIII

HIGHWAY BONDS 160

Adams on Public Borrowing—Bastable—Shirras—Lutz—Basic Considerations—Wealth Production—Life of Bonds—Life of Improvement—Pay-as-you-go—Highway Engineering—Traffic—Research—Opinions of Highway Officials—History of Highway Bonds—Statistical Data.

CHAPTER IX

SPECIAL ASSESSMENTS 195

Definition—Origin and Development—Legal and Constitutional Status—Police Power—Eminent Domain—Taxing Power—General Applications—Fiscal Status—Theory of Benefits—Special Taxes—Tax and Debt Limitations—Proportionality—Faculty—Progressivity—Capital Account—Apportionment of Benefits—Methods of Assessment—Assessment Practice in the United States—Examples of Assessment.

CHAPTER X

TECHNICAL FUNCTIONS OF HIGHWAY DEPARTMENTS 222

Central Office—Location—Design—Bridges and Culverts—Standard Plans—Inspection of Materials—Inspection of Construction—Correlation of Inspection—Types of Inspectors—District Engineer System—Specification Writing—Promotion of Highway Improvement—Financial Planning.

CHAPTER XI

MUNICIPAL HIGHWAY DEPARTMENTS 251

Origin of the Street Commissioner System—The City Surveyor—The Department of Public Works—Politics—Technical Problems—

PAGE

Plight of the Small City—Functions of Technical Staff—Trend of the Times—Inauguration of Improvements—Problems for the Future.

CHAPTER XII

ORGANIZATION AND ADMINISTRATION OF CONSTRUCTION 265
Definitions—Elements or Organization—Project Analysis—Operation Analysis—Progress Diagrams—Lost Time in Construction—Estimates — Job Organization — Superintendence — Efficiency Studies—Coordination—Time Studies—Cost Keeping—Accounting.

CHAPTER XIII

CONTRACT AND DAY-LABOR CONSTRUCTION. 305
Basis of Discussion—Ideal Conditions—Superintendence—Political Interference—Labor Problems—Equipment Problems—Influence of Type of Construction—Cost—Control—Changes in Plans—Contract Price—Risks—Inspection—Investment in Plant—Trend of Expert Opinion.

CHAPTER XIV

FORMAL INSTRUCTIONS, PAPER WORK, AND REPORTS 314
Team Work—Motivation—Classes of Employees—Problems of Management—General Instructions—Instructions to Field Personnel—Instructions to Office Personnel—Periodic and Special Reports—House Organs.

CHAPTER XV

THE FIELD OF HIGHWAY ENGINEERING 328
Growth of Highway Engineering -Materials Problems—Design Problems—Contract Practice—Administrative Duties—Financial Problems—Efficiency Studies—Social and Economic Problems—Publicity—Personal Relationships—Public Relationships—Professional Enthusiasm—Compensation—Minimum Specifications for Highway Engineering Positions.

CHAPTER XVI

CIVIL SERVICE IN THE HIGHWAY FIELD 347
Status of Civil Service—Civil Service Ideals—Appointment Methods—Promotion—Compensation—Tenure of Service—Operation of Civil Service—Assembled Examinations—Unassembled Examinations—Promotional Examinations—Dismissal—Efficiency — Stabilization—Inflexibility — Morale — Discipline—Individual Opportunity—Application to Highway Conditions.

PAGE

CHAPTER XVII

ECONOMICS OF HIGHWAY TRANSPORTATION 358
Basis of Promotion—Economic Status of Highways—Elements of Highway Transport System—Cost of Transportation—Road Costs—Vehicle Costs—Creation of Wealth—Social Considerations—Educational Considerations—Traffic—Regulation of Traffic—The Highway Common Carrier—Load Regulations—Speed Regulations—Size Regulations—Licenses and Fees.

INDEX . . . 375

HIGHWAY ADMINISTRATION AND FINANCE

CHAPTER I

HISTORY OF NATIONAL HIGHWAY ADMINISTRATION

INTRODUCTION

The Constitution.—The Constitution of the United States had its origin in disordered finance and prostrate commerce—disordered finance due to the fact that the Articles of Confederation had provided for a mere league of states without the power of taxation, and prostrate commerce because no central authority existed with adequate power to regulate and control commerce among the several states.

During this critical period of American history, the majority of the leaders recognized the necessity of national control of interstate commerce. Efforts to secure that finally culminated in the adoption of a resolution by the legislature of Virginia appointing commissions to meet such other commissions as might be appointed by other states to consider the trade of the Union, and to determine how far a uniform system of commercial regulations might be necessary and desirable.

In conformity with this resolution, delegates from five states met at Annapolis the first Monday in September, 1786. This convention, which had originated out of the desirability of regulating commerce on the Potomac River, accomplished nothing constructive, but was destined to become famous for the reason that a resolution, drafted by Alexander Hamilton and unanimously adopted, proposed a convention of delegates from all the states to meet at Philadelphia the second Monday in May, 1787.

. . . to take into consideration the situation of the United States, to devise such further provisions as shall appear to them necessary to render the constitution of the federal government adequate to the exi-

gencies of the Union; and to report such an act for that purpose to the United States in Congress assembled, as, when agreed to by them, and afterwards confirmed by the legislatures of every state, will effectually provide for the same.[1]

This resolution, addressed to Congress and to the separate governments of all the states, was not formally approved, but had the desired effect. Congress, on Feb. 21, 1787, called a convention to meet at the time and place provided for in the Hamilton resolution "for the sole and express purpose of revising the Articles of Confederation" and to report such amendments as would "render the federal constitution adequate to the exigencies of government, and the preservation of the Union."[2]

The constitutional convention that assembled in obedience to this call drafted a supreme law, which, after being ratified by the required number of states, did in fact provide "a more perfect union" embracing a definite group of distinctly national powers including the necessary rights of Congress "to lay and collect taxes, duties, imposts, and excises; to pay the debts and provide for the common defense and general welfare of the United States"; "to establish post offices and post roads"; and finally, "to make all laws which shall be necessary and proper for carrying into execution the foregoing powers, and all other powers vested by this constitution in the government of the United States, or in any department or office thereof."[3]

Aside from the definite authority vested in Congress to establish "post roads," the right to construct and maintain, or to aid in the construction and maintenance of public highways, would seem to be definitely implied in the power of Congress to "make all laws which shall be necessary and proper for carrying into execution" the power "to regulate commerce . . . among the several states." Yet the important part which Congress, prior to the era of practical railroad building, was obliged to take in the highway problem became a part of the battleground between the advocates of a strict, and those of a liberal, construction of the fundamental law of the land.

Ideas of Washington. – Before passing to a brief narrative of the essential facts of national highway development during the early history of the Republic, reference should be made to the

[1] ELLIOTT, "Debates," vol. 1, p. 118.

[2] *Journal of Congress*, Feb. 21, 1787.

[3] Constitution of the United States, Art. I, Sec. 8.

practical vision of George Washington as to the importance of connecting the East and the West by ties of commercial intercourse. In his day this meant the best or most practicable routes through the passes of the Appalachians to the Ohio Valley.

There is a report in Washington's handwriting, bearing the date 1754, stating the difficulties involved in making the Potomac River navigable.[1] He had just returned from a trip across the Alleghanies as a special messenger from Governor Dinwiddie to the French commander on the Ohio River, and on the basis of data collected at that time, Washington mapped out a route from Cumberland over the mountains, which was later followed by the Cumberland turnpike, the great National Road, and still later by the Connelsville line of the Baltimore and Ohio Railroad from Pittsburgh to Cumberland.[2] As a young surveyor in the period before the Revolution, as a colonel on the ill-fated expedition of General Braddock, and later as commander of the American army, George Washington had every opportunity to study the geography of his country, and his writings reveal the fact that he was a careful student of commercial, as well as political and military problems. In a letter to Thomas Johnson, dated July 20, 1770, he suggests the opening up of the Potomac, including the passage to Cumberland and connection, by portage, with the Ohio waters "as a means of becoming the channel of conveyance of the extensive and valuable trade of a rising empire."[3]

Washington's interest in these matters was interrupted by the Revolution, but in 1784 he made another trip to the west, employing assistants at his own expense, to map out the different routes to the Ohio Valley. He reached the conclusion that the shortest and least expensive route was by way of the Potomac, and, in conference with representatives from Maryland, he mapped out a plan which resulted in the organization of the Potomac Company, of which he served as first president, 1785–1788, retiring when he was elected President of the United States. It is not too much to say that one of Washington's real claims to the gratitude of his countrymen is based on the fact that he

[1] STEWART, ANDREW, *Report on the Chesapeake and Ohio Canal*, p. 1, 1826.

[2] ADAMS, HERBERT B., "Washington's Interest in the Potomac Company," in "Johns Hopkins University Studies in Historical and Political Science," vol. 3, p. 80.

[3] STEWART, ANDREW, *Report on the Chesapeake and Ohio Canal*, pp. 27–29, 1826.

was one of the first great statesmen to recognize the necessity of connecting the East with the Ohio Valley by ties of commercial intercourse a necessity arising out of political and military conditions, as well as business profits. With "the flanks and rear of the United States" possessed by the great foreign powers, Spain and England, Washington saw clearly the importance of trade routes not only by way of the Potomac but farther North, *via* the Mohawk and Hudson to New York, and South, *via* the James to the Kanawha and thence to the Ohio.[1]

THE CUMBERLAND ROAD

The first efforts to realize the great practical vision of George Washington were in the form of canals and turnpike roads constructed by the prodigal expenditure of state money and fairly substantial contributions on the part of the federal government. A summary of the more significant facts is necessary to an appreciation of the events of more recent years, and is presented for that purpose.

The Appalachians.—The Appalachian chain of mountains, which, during the colonial period, had been a protection for the settlers from attack by the French and Indians, thus tending to promote some small spirit of nationality among the colonies, was now a barrier which had to be overcome in order to take possession of the vast territory to the west, acquired under the terms of the Treaty of Paris at the close of the Revolution.[2]

One of the principal routes across the mountains, and the most direct from Washington, D. C., and Baltimore, was from Cumberland on the Potomac, in Maryland, to Wheeling, West Virginia, on the Ohio. This road passed through the southwestern part of Pennsylvania and followed roughly the route taken by General Braddock on his campaign against the French and Indians at Fort Duquesne, later Fort Pitt, and now Pittsburgh. The so-called Cumberland Road, which followed this route, was the first turnpike toll road to receive national aid, although not the first to be constructed, that honor belonging to the Philadelphia and Lancaster Turnpike, begun in 1792.[3] The

[1] Hulbert, "The Paths of Inland Commerce," pp. 9–10, 1920.

[2] Meyer, "History of Transportation in the United States before 1860," pp. 5–6.

[3] Page, "Progress and Present Status of the Good Roads Movement in the United States," in "Yearbook of the United States Department of Agriculture," p. 268, 1910.

federal government, however, had already been involved in the general problem of road building by the laying out of Zane's Trace in 1797 and the establishment of more roads to the west.[1]

The Road Fund.—The Cumberland Road had its origin in a letter written by Albert Gallatin, Feb. 13, 1806, to William B. Giles of Virginia, who was Chairman of the committee to consider the admission of Ohio into the Union.[2] Gallatin proposed that one-tenth of the net proceeds from the sale of land by the national government within the new state should be used for the construction of roads from the Atlantic seaboard to the Ohio Valley and later to the Mississippi. Three-fifths of said fund was to be used for the construction of roads within the state and the other two-fifths for building a road over the mountains to the east.

The same general plan was followed in the case of certain other states on their admission into the Union. In 1811, 5 per cent of the net proceeds of the sales of public lands in Louisiana was given to that state for the construction of roads and levees and the same relative amounts to Indiana, 1816, Missouri, 1820, Iowa, 1845, and Mississippi, 1817. A 2 per cent fund was given to Illinois, 1818.[3] In 1817 an effort was made by Clay and Calhoun to have the bonus and dividends received from the newly chartered Bank of the United States set aside for roads and canals, but this plan was defeated by the veto of President Madison.[4] The new President, Monroe, held the same strict construction ideas on this subject as did President Madison, but it is instructive to note that Calhoun, who later was destined to hold these same ideas, was the author of the bill under consideration and in defense of the measure said:

> We are under the most imperious obligation to counteract every tendency to disunion . . . Whatever impedes the intercourse of the extremes with this, the center of the Republic, weakens the Union.[5]

Suffice it to say that this additional source of revenue for the benefit of internal improvements was made impossible by the veto of Madison and the later concurrence of Monroe.

[1] MEYER, "History of Transportation in the United States before 1860," p. 13.

[2] ADAMS, "Writings of Gallatin," vol. 1, p. 76.

[3] HOLT, "The Bureau of Public Roads, Its History, Activities and Organization," Institute for Government Research, Monographs of the United States Government, 26, pp. 3–4.

[4] RICHARDSON, "Messages and Papers of the Presidents," vol. 1, p. 584.

[5] CALHOUN, "Works" (Cralle's ed.), vol. 2, p. 190.

In December, 1805, a Senate committee was appointed to bring in a report on that part of the act admitting Ohio into the Union, which provided for a 2 per cent fund for the construction of a road across the mountains from the seaboard to the Ohio Valley. The report favored the route from Cumberland on the northern bank of the Potomac, in Maryland, to a point on the Ohio near Wheeling, West Virginia. This route, it was alleged, would accommodate traffic from Baltimore and the District of Columbia, would cross the Monongahela at, or near, Brownsville, thus taking advantage of navigation, and would have good western connections into the new state of Ohio. The committee noted that Pennsylvania was already engaged in making roads from Philadelphia to Pittsburgh and that, all things considered, the proposed road by way of Cumberland and Wheeling should be a continuation of the Maryland road.[1]

The Act of 1806.—The report of the committee was accepted, and on Mar. 29, 1806, "an act to regulate the laying out and making of a road from Cumberland in the state of Maryland to the state of Ohio,"[2] was finally approved by Congress. Three disinterested commissioners were appointed under the authority of the act, to lay out the road under the restrictions as to termini. In their first report, the commissioners took into consideration the shortness of distance between points of navigation on eastern and western waters, the best methods of diffusing benefits, and the comparative merits of various towns and settlements. The route recommended followed in general the old Braddock Road, which itself had roughly followed the course of an Indian path.[3] The consent of the state of Pennsylvania to the construction of the road had not yet been obtained, but it was granted on Apr. 9, 1807, by the legislature, on condition that the route be so changed that it would pass through Uniontown and Washington in Fayette County, if the same could be done in conformity with the Act of Congress.[4] The road was finally located as desired by Pennsylvania, and followed closely an old road between Uniontown and Brownsville, laid out in 1774.[5] In a contest

[1] "American State Papers, Miscellaneous," vol. 1, p. 432.

[2] MEYER, "History of Transportation in the United States before 1860," p. 14.

[3] "American State Papers, Miscellaneous," vol. 1, pp. 432, 474.

[4] YOUNG, "A Political and Constitutional Study of the Cumberland Road," pp. 21, 22.

[5] SEARIGHT, "The Old Pike," p. 244.

over the terminus on the Ohio, Wheeling won out over Steubenville, through the influence of Henry Clay, and thus, by 1811 the entire road had been located to the Ohio Valley.[1]

First Contract.—The first contract for construction work on the road was awarded in 1811, and the road was open for traffic as far as Wheeling in 1818. The road was completed from Cumberland to Uniontown at a cost, including all expenses of survey and location, salaries, bridges, and some repairs, of $9,745 per mile. The average cost of the entire road from Cumberland to Wheeling was nearly $13,000 per mile, showing that the eastern division was much less costly than the western. This was charged to some prodigality in the extent of the work and too liberal contracts.[2]

Other Appropriations.—With an economic depression in the country, 1819–1820, and a deficit in the Treasury, announced by Secretary Crawford, the demand for economy made itself felt in Congress, thus slowing down the progress of internal improvements. In spite of this condition, it appears that the demand for a highway to the West was so pronounced that $535,000 was appropriated by Congress, Mar. 3, 1819, of which $250,000 was for new work.[3] Additional appropriations were very small, however, until 1825, when the competition of the Erie Canal emphasized the importance of a better land route to the South. On Apr. 11, 1820, $141,000 was appropriated, but this was to complete the eastern section of the road to Wheeling.[4] The next appropriation of $25,000, made in 1823, was to repair the road east of Wheeling. Not until Mar. 3, 1825, was an appropriation of $150,000 made to extend the road from the Ohio River to Zanesville,[5] although in 1820 the small sum of $10,000 had been set aside by Congress to make a survey between Wheeling and the Mississippi River.[6]

The following statistical table gives the chapter number, date, amount appropriated, and reference to thirty-four different Acts of Congress making appropriations for the survey, construction or repair of the Cumberland Road:

[1] YOUNG, "A Political and Constitutional Study of the Cumberland Road," p. 23.

[2] SEARIGHT, "The Old Pike," pp. 319–320.

[3] "United States Statutes at Large," vol. 3, pp. 500, 501.

[4] "United States Statutes at Large," vol. 3, p. 560.

[5] *Ibid*, vol. 4, p. 128.

[6] *Ibid*, vol. 3, p. 605.

TABLE I.—APPROPRIATIONS FOR THE CUMBERLAND ROAD[1]

Chapter	Reference	Date	Amount
19	2: 359	Mar. 29, 1806	$ 30,000.00
8	2: 555	Feb. 14, 1810	60,000.00
45	2: 661	Mar. 3, 1811	50,000.00
33	2: 690	Feb. 26, 1812	3,786.60
78	2: 730	May 6, 1812	30,000.00
58	2: 829	Mar. 3, 1813	140,000.00
43	3: 206	Feb. 14, 1815	100,000.00
45	3: 282	Apr. 16, 1816	300,000.00
60	3: 426	Apr. 14, 1818	312,984.60
54	3: 500	Mar. 3, 1819	535,000.00
40	3: 560	Apr. 11, 1820	141,000.00
123	3: 605	May 15, 1820	10,000.00
17	3: 728	Feb. 28, 1823	25,000.00
98	4: 128	Mar. 3, 1825	150,000.00
13	4: 148	Mar. 14, 1826	3,411.03
17	4: 151	Mar. 25, 1826	110,749.00
29	4: 215	Mar. 2, 1827	170,510.00
44	4: 228	Mar. 2, 1827	30,000.00
56	4: 275	May 19, 1828	175,000.00
30	4: 351	Mar. 2, 1829	100,000.00
31	4: 352	Mar. 2, 1829	50,000.00
53	4: 363	Mar. 3, 1829	100,000.00
232	4: 427	Mar. 31, 1820	215,000.00
63	4: 469	Mar. 2, 1832	244,915.85
153	4: 552–8	July 3, 1832	425,868.00
69	4: 649	Mar. 2, 1833	459,440.00
68	4: 680	June 24, 1834	750,000.00
92	4: 698	June 27, 1834	1,609.36
31	4: 772	Mar. 3, 1835	646,186.58
41	4: 777	Mar. 3, 1835	320.00
264	5: 71	July 2, 1836	600,000.00
46	5: 195	Mar. 3, 1837	397,183.63
84	5: 228	May 25, 1838	459,000.00
105	5: 695	June 17, 1844	1,359.81
Grand Total....	.....	.....	$6,828,324.46

[1] United States Statutes at Large.

It will be observed that the total amount appropriated was $6,828,324.46, which is slightly different from the sum of $6,824,919.33 given by Young and evidently quoted from Hulbert.[1] These writers both overlooked an appropriation of

[1] YOUNG, "A Political and Constitutional Study of the Cumberland Road" (see map on front page). Also, HULBERT, "The Old National Road," p. 149.

$5,868 to Lucius W. Stockton for repairs on the road,[1] and made a number of other slight errors which have been discovered by a careful study of the Acts of Congress, noted in Table I. Two other writers give the cost of the Cumberland Road as about $6,861,200,[2] which is substantially correct. One writer, however, gives the expense to Congress of the road from Cumberland to Vandalia as $4,300,000, and states that the same was completed to Vandalia in 1838, neither of which statements is even approximately correct.[3]

West of Ohio River.—Following the Act of 1825 to construct the road west of Wheeling, and influenced by the opening of the Erie Canal and the economic expansion after the crisis of 1819, work was pushed forward rapidly. On July 4, 1825, ground was broken with great ceremony at St. Clairsville, and the orator of the day predicted that the road was "destined to reach the Rocky Mountains."[4] As a matter of fact, the road was never completed beyond Springfield, Ohio, although it was partly completed as far as Vandalia, Illinois, and projected to Jefferson City, Missouri, to cross the Mississippi River at some point between Alton and St. Louis. The continuity of the road, moreover, was broken in deference to insistent local demands for the improvement, which was contrary to the original plan of the federal government. Certain cities, such as Indianapolis, became centers of activity and secured the construction of short stretches of road in much the same way that a few miles of paved road recently have been built here and there on the state trunk highways. Appropriations were made annually, with one exception, from 1825 to 1838, inclusive, for continuing the Cumberland Road through Ohio, the total being $2,081,008.36. Appropriations for the road in Indiana began in 1829 and continued to 1838, the total sum being $1,135,000, while in Illinois the amount expended, 1830–1838, was $746,000.[5]

Money Advances.—It will be recalled that the historic national highway under consideration had its origin in the 2 per cent fund

[1] "United States Statutes at Large," vol. 4, p. 552. Also, HULBERT, "The Old National Road," p. 149.

[2] LIPPINCOTT, "Economic Development of the United States," p. 233; FAULKNER, "American Economic History," p. 315.

[3] BOGART, "Economic History of the United States," p. 199, 1924.

[4] YOUNG, "A Political and Constitutional Study of the Cumberland Road," p. 33.

[5] *Ibid.*, p. 33.

arising from the sale of public lands in the state of Ohio. A similar fund was pledged in Indiana and Illinois for the same purpose. In most cases appropriations for the Cumberland Road were made under the fiction of advances from the 2 per cent fund in Ohio, Indiana, Illinois, and Missouri, although the road was fully completed only to Springfield, Ohio, and partially completed to Vandalia, Illinois, and never reached the state of Missouri. Some appropriations for the road were general, others special, some military, and in one case, 1844, "civil and diplomatic." As a general rule, money for repairs was provided from funds in the treasury not otherwise appropriated, and not reimbursable from the road fund proper, and the same is true of an appropriation for a survey in 1820.

In spite of the legal provisions regarding advances, the facts are that the sale of public lands did not bring in the amount of money anticipated, and in 1838 when the last funds were authorized by Congress, the 2 per cent fund for the four states, Ohio, Indiana, Illinois, and Missouri, amounted to only $972,978.20, or about one-seventh of the sum actually expended on the road, as indicated in Table I.[1] In the meantime, the sale of public lands had become less a matter of obtaining revenue, as originally planned, than of encouraging the western movement of American democracy.

Specifications.—According to the articles of agreement made in 1811 between Albert Gallatin, Secretary of the Treasury, and the contractor for a "certain part of the road leading from Cumberland in the state of Maryland to Brownsville in the state of Pennsylvania," the specifications for the construction of the road were in part as follows:

> The trees to be cut down and cleared the whole width of sixty-six feet, according to the fourth section of the act above mentioned; the stumps to be grubbed, and the bed of the road to be levelled thirty feet in width; the hills to be cut down, the earth, rocks, and stones to be removed, the hollows and valleys, and the abutments of all the bridges and culverts to be filled, so that the whole of the road on the aforesaid width of thirty feet, to be reduced in such manner, that there shall not in any instance be an elevation in said road when finished, greater than an angle of five degrees with the horizon, nor greater than the gradation fixed by the commissioners who laid out the road, and so that the surface of the said road shall be exactly adapted to the marks or stakes, made or to be made, by the person appointed super-

[1] *Ibid*, p. 94.

intendent for the said road by the President of the United States . . . The road to be covered twenty feet in width, with stone eighteen inches in depth in the middle, and diminishing to twelve inches at the sides; the upper six inches thereof to be broken to such a size that each particle thereof will pass through a ring of three inches in diameter, and the remaining or lower stratum to be broken so as to pass through a seven-inch ring.[1]

With the exception of the most general requirements regarding grade, drainage, and surfacing, all details were left to the discretion of the President, acting through a superintendent and other appointed officials.[2]

Cost of Road.—The somewhat expensive character of the road between Cumberland and Brownsville clearly indicated by the specifications, was modified from time to time to provide less costly, although less permanent, construction. The average cost of the road in Ohio was only $3,400 per mile, whereas from Cumberland to Brownsville, a distance of 74 miles, the average cost had been $11,226.55 per mile, and from Brownsville to Wheeling, a distance of 56 miles, $15,705.90 per mile; the variations in cost being due to differences in the topography of the country as well as to variations in the specifications provided for the various sections.

Tolls.—The maintenance of the road up to the time it was turned over to the states was provided for by direct appropriations of Congress and by tolls which were state, rather than national, in character, as a result of the veto of President Monroe in 1822, to be noted later.[3] A study of the amount of tolls collected for the use of the Cumberland Road by the various states is an index of the large volume of business done. Space will permit reference to the toll question in only one state, and Ohio may be taken as a typical example. Table II shows that during the 47 years, 1831 to 1877 inclusive, Ohio received in tolls the sum of $1,139,795.30.

The laws of Ohio also may be taken as quite typical of the legislation in other states. It was necessary for Congress to give its consent to legislation providing for a system of state tolls on a national highway, a compromise on constitutional questions respecting internal improvements. Accordingly, there was

[1] "American State Papers, Miscellaneous," vol. 2, pp. 175–176.
[2] "United States Statutes at Large," vol. 2, p. 358.
[3] "Messages and Papers of the Presidents," vol. 2, p. 142.

TABLE II.—CUMBERLAND ROAD TOLLS IN OHIO[1]

Year	Tolls	Year	Tolls
1831	$ 2,777.16	1855	$ 6,105.00
1832	9,067.99	1856	6,105.00
1833	12,259.42	1857	6,105.00
1834	12,693.65	1858	6,105.00
1835	16,442.26	1859	5,551.36
1836	27,455.13	1860	11,221.74
1837	39,843.35	1861	21,492.41
1838	50,413.17	1862	19,000.00
1839	62,496.10	1863	20,000.00
1840	51,364.67	1864	20,000.00
1841	36,951.33	1865	20,000.00
1842	44,656.18	1866	19,000.00
1843	32,157.02	1867	20,631.34
1844	30,801.13	1868	18,934.49
1845	31,439.38	1869	20,577.04
1846	28,946.21	1870	19,635.75
1847	42,614.59	1871	19,244.00
1848	49,025.66	1872	18,002.09
1849	46,253.38	1873	17,940.37
1850	37,060.11	1874	17,971.21
1851	44,063.65	1875	17,265.12
1852	36,727.26	1876	9,601.68
1853	35,354.40	1877	288.91
1854	18,154.59		
	Total.....	....	$1,139,795.30

[1] HULBERT, "The Old National Road," pp. 73-74.

enacted "an act declaring the assent of Congress to an act of the general assembly of the state of Ohio, hereinafter recited," which after providing a schedule of rates, stipulates:

That no toll shall be received or collected for the passage of any stage or coach conveying the United States' mail, or horses bearing the same, or any wagon or carriage laden with the property of the United States, or any cavalry or other troops, arms, or military stores belonging to the same, or to any of the states comprising this Union, or any person or persons on duty in the military service of the United States, or of the militia of any of the states.[1]

Constitutionality.—The constitutionality of constructing internal improvements by federal appropriations has been a much debated question. James Madison, in the constitutional convention, favored giving Congress the power to construct internal

[1] "United States Statutes at Large," vol. 4, p. 484.

improvements, but his ideas were not accepted; and later, partly for that reason, no doubt, his understanding of the Constitution was such that he could not approve the Bonus Bill. Young, after making a careful study of the legal and political aspects of internal improvements, says:

> It is clear that the attitude of the Constitution, as understood by those who framed it, was opposed to a federal fund for internal improvements. Such a fund was to be raised in the states by means of tonnage duties.[1]

As a matter of fact, Congress for a time did give its consent to the levy of tonnage duties by the states. When Vermont, Kentucky, and Tennessee, states not having a seacoast, were admitted into the Union, the shortsighted character of the policy of obtaining revenue for internal improvements by means of tonnage duties at once became apparent. The problem of prosecuting and financing internal improvements forthwith became a leading political issue and remained so for more than a generation.

The question of constitutionality involved may be considered from four distinct standpoints: first, the power of Congress to appropriate money for improvements of limited benefit, say to a section of the state or to a city; second, the same power when the improvements are truly national in character; third, the power of Congress through its own agencies to construct the improvements for which the necessary funds are appropriated; and finally, the power of Congress to exercise actual jurisdiction over the improvements after they are completed. This, in a case like the Cumberland Road, would mean the erection of tollgates to collect funds for the maintenance of the road. It would include the exercise of police powers, eminent domain, and all other powers necessary to carry into effect a complete national policy. None of these powers is vested in Congress except by reasonable implication. John Marshall's famous doctrine of implied powers must, and does, come to the rescue. The whole problem of the powers of Congress over internal improvements was left undecided by the Constitutional Convention, a fact well understood by James Madison. The solution of this problem that finally resulted from a generation or more of political controversy, congressional oratory, veto messages, and court decisions was a genuine English compromise if there ever was one—a compro-

[1] YOUNG, "A Political and Constitutional Study of the Cumberland Road," p. 39.

mise which forms the constitutional basis of our present policy of national aid.

The historical evolution which resulted in this compromise is admirably presented in Gallatin's report of Apr. 6, 1808,[1] and the comments of Young thereon,[2] the attitude of Congress, and the three famous veto messages of Madison, Monroe, and Jackson. The whole controversy forms an instructive and lengthy chapter in American history.

The Cumberland Road was originally authorized by Congress under the fiction of a "compact" with the state of Ohio, whereby 2 per cent of the proceeds of the sale of public land in that state was to be used to construct a great national highway across the mountains, the money appropriated out of the national treasury being "advances" to be reimbursed later out of the 2 per cent fund. The fact that the "advances" thus made under the "compact" with Ohio and later with Indiana, Illinois, and Missouri, were about 85 per cent "fiction," even from a quantitative point of view, is clear, in view of the fact that only about one-seventh of the money expended on the Cumberland Road was ever reimbursed from the proceeds of the sale of public lands. The "compact" with Ohio, accepted by Congress in 1806, served its purpose as a good working substitute for the doctrine of implied powers that was later to follow, and the "fiction" of "advances" thus made possible a beginning of the national pike.[3]

Congress and the President, however, were not long in broadening the "compact" theory in connection with the Cumberland Road. Both Jefferson and Gallatin, in spite of their strict construction ideas, were warm advocates of internal improvements. Congress, in passing the Bonus Bill, departed from the "compact" idea and affirmed its constitutional right not only to appropriate for, but actually to inaugurate, a system of internal improvements.[4] Following the veto by Madison, and the message of Monroe to Congress, endorsing the same both in letter and spirit, the matter was referred to a special committee of

[1] "Miscellaneous State Papers," vol. 1, p. 741.

[2] YOUNG, "A Political and Constitutional Study of the Cumberland Road," p. 49.

[3] See *Annals of Congress*, Eighth Congress, First Session, pp. 254, 263, 273, 297, 305, 631, 876, 943, 986, 1012, 1241, 1242; Second Session, pp. 27, 28, 32, 37, 43, 63, 689.

[4] YOUNG, "A Political and Constitutional Study of the Cumberland Road," p. 66.

Congress which presented a report Dec. 15, 1817, claiming that Congress had the power, first, to lay out, construct, and improve post roads; second, to open, construct, and improve military roads; and third, to cut canals through the several states with their consent. The committee also denied that these recommendations meant a liberal construction of the Constitution such as, under the circumstances, would be justified. Both Clay and Calhoun at this time held much more liberal views regarding implied powers than either Madison or Monroe. Clay believed that Congress had the authority to construct roads without the consent of the states, and declared, referring to implied powers, that "a grant of the end is a grant of the means" for the accomplishment of that end.[1]

The report of the Special Committee as agreed to by the Committee of the Whole was accepted only in part by the House, and that not by sufficient majority to pass it over a veto.

The presidents, however, in their veto power, were destined to place a very serious limitation on the real authority of Congress in the matter of internal improvements. The veto messages of Madison, Monroe, and Jackson in connection with appropriations to the Cumberland Road are of special importance in view of the recent trend of events in the promotion of a national highway policy.

Madison Veto.—When Calhoun brought forth his bill in 1816 providing for the use by Congress, in the construction of roads and canals, of the bonus of $1,500,000 paid by the Bank of the United States, including the future dividends on the stock of said bank held by the general government, the issue was squarely drawn between President Madison on the one hand and Clay and Calhoun on the other. Clay and Calhoun were rising young statesmen with liberal views of the Constitution, holding that the doctrine of implied powers was "necessary and proper" to establish post roads, and that adequate provision for the transportation of mail and military supplies was a plain matter of "common defense and general welfare." President Madison did not accept this liberal view and sent his veto message on the Bonus Bill Mar. 3, 1817, the day before his term expired. In his "farewell address" he warned against too liberal an application of the doctrine of implied powers, although he had signed numerous bills extending the constitution far in advance of the

[1] *Annals of Congress*, Fifteenth Congress, First Session, p. 1362.

ideas held, but not always practiced, by Jefferson, his predecessor in the Presidency.[1] The famous veto message of President Madison was a direct challenge to the liberal construction views of Clay and Calhoun.[2]

Monroe Veto.—President Monroe took office with substantially the same views regarding internal improvement as those held by President Madison. In 1822 a bill was introduced in Congress authorizing the president to cause tollhouses to be erected on the Cumberland Road, appoint toll gatherers with power to enforce the collection of tolls, and provide a system of fines for the violation of the laws of the road. Here was a proposed measure, which, if adopted, would provide a complete system of internal improvements with the right of jurisdiction and sovereignty over the same by the national government. Thus, the position taken by Clay and his followers in the West is not only far in advance of the "compact" theory of 1806, but also much more liberal than that taken by Calhoun in his Bank Bonus Bill which was vetoed by President Madison. The issue was again squarely drawn and a decision reached that had a great influence on the present national-aid policy for the construction of public highways. The bill passed the House by a vote of eighty-seven to sixty-eight and the Senate by a vote of twenty-nine to seven, the western states represented in the House being in the affirmative with the exception of two members from Tennessee,[3] but was promptly vetoed by President Monroe.[4]

The paper expressing the "Views of the President of the United States on the Subject of Internal Improvements,"[5] submitted to Congress on the same day as the veto, is a document dealing in a judicial manner with one of the great questions of that generation. The paper contains not only a constitutional history of internal improvements, but also gives a careful analysis of Monroe's construction of the Constitution with special reference to the relation of the states and the nation under the theory of divided sovereignty. Monroe was opposed to the exercising of administrative powers by the United States in either construction

[1] Babcock, "The Rise of American Nationality," p. 255.

[2] Richardson, "Messages and Papers of the Presidents," vol. 1, pp. 584–585.

[3] Turner, "Rise of the New West," p. 231.

[4] Richardson, "Messages and Papers of the Presidents," vol. 2, pp. 142–143.

[5] *Ibid.*, pp. 144–183.

or jurisdiction, but he did favor the appropriation of funds by the United States for internal improvements under the head of the "general welfare." This seemed in a measure to obviate the difficulty raised by President Madison and brought the President into harmony with the vote of Congress in 1818, and with the people, generally, on the power to tax and appropriate for internal improvements.[1]

Jackson Veto.—It remained for President Jackson to hasten the end of a system of internal improvements by the general government. As a senator from Tennessee he had favored various works of internal improvement, but, in the meantime, for various reasons, he had become convinced that in many cases the improvements were local rather than national in character. When a bill passed Congress authorizing the United States to subscribe for stock for a road running south from Zanesville, Ohio, Jackson promptly vetoed it, partly because of strict construction scruples, but mainly for the reason that he believed the improvement to be a local and not a national road.[2] On the very same day that the Zanesville road veto was submitted, he approved another bill appropriating money for the extension of the Cumberland Road, and various sums for other roads that he was pleased to regard as of a national character.[3] Perhaps his position in these matters may not have been consistent, but consistency was a jewel, even during the presidency of Andrew Jackson.

Politics.—Something should now be said regarding the politics of the Cumberland Road as a matter of information and because politics of about the same brand is a real force today in the construction and maintenance of public highways, especially in determining the trunk-line road systems of the various states and the roads that are entitled to the benefit of federal aid. No sooner had the national road been started than a political contest arose to have the route diverted from a direct course in order to pass through the town of Washington, Pennsylvania. The people of Pennsylvania believed that the road was being constructed for the special benefit of Baltimore, a competitor of Philadelphia for the trade of the West. The legislature of Penn-

[1] YOUNG, "A Political and Constitutional Study of the Cumberland Road," pp. 67–70.

[2] RICHARDSON, "Messages and Papers of the Presidents," vol. 2, pp. 483–494.

[3] United States Statutes at Large," vol. 4, pp. 427–428.

sylvania, in passing an act giving consent to the construction of the road in that state, made the following reservation:

> *Resolved*, That the route laid down and reported by the commissioners to the President of the United States be so altered as to pass through Uniontown in the county of Fayette, and Washington in the county of Washington, if such alteration can, in the opinion of the President, be made consistently with the provisions of an act of Congress passed Mar. 29, 1806; but if not, then over any grounds within the limits of the state which he may deem most advantageous.[1]

This policy of endeavoring to dictate the route along with the consent of a state played an important part in the history of the National Road. Even Gallatin, who formerly lived in Washington County, used the great weight of his political influence in this matter by writing to Jefferson that Washington County

> . . . gives a uniform majority of about two thousand votes in our favor, and if this be thrown by reason of this Road in a wrong scale, we will infallibly lose the state of Pennsylvania at the next election . . . I have been reminded of this subject by the enclosed letter from an influential and steady Republican of that county.[2]

Jefferson deplored this situation, but after Congress had passed an act in 1811 permitting the President to make deviations, the route was finally changed to pass through Washington as demanded by the Legislature of Pennsylvania.

The efforts of Dayton and Eaton, Ohio, to influence the President to change the location of the National Road in Ohio, through local and state politics, is typical. Fortunately, Congress sustained the President, and the direct line remained the established route in Ohio, in spite of the efforts of Dayton, Eaton, and the Ohio Legislature.[3]

The bitter contest waged by Illinois and Missouri over where the National Road should cross the Mississippi River was a leading factor in bringing to an end in 1838 the appropriations of Congress for this national highway. This struggle had lasted for 18 years. Missouri demanded the St. Louis crossing and Illinois the one at Alton. In 1834 the Legislature of Illinois resolved:

[1] Laws of Pennsylvania, p. 185, 1807.

[2] Adams, "Writings of Gallatin," vol. 1, p. 395.

[3] Young, "A Political and Constitutional Study of the Cumberland Road," pp. 25–27.

That the consent of the State of Illinois is hereby given to the Federal Government to extend the National Road through the territory of said state so as to cross the Mississippi River at the town of Alton in said state and at no other point.[1]

The controversy was never settled by Congress, as the road was never officially located west of Vandalia, Illinois.

Road Abandoned.—The National Road was finally abandoned by Congress and ceded to the states through which it passed. One reason for this was the constant political effort regarding the location of the various sections of the road. Politics on a larger scale was also a factor. Clay was not interested in the road after the veto by President Jackson of the appropriation for a road south from Zanesville. If that project had been completed, it would have benefited Clay's home state of Kentucky. Calhoun had completely changed his position on internal improvements, as he had also on the tariff and the question of secession. New York with its Erie Canal affording a route to the West, was naturally opposed to the project. The same was true, in a somewhat lesser degree, of Pittsburgh and Philadelphia, and therefore the state of Pennsylvania.

The maintenance cost of the road and the estimates of necessary increased expenditure had great weight in Congress, while the original "compacts" with Ohio, Indiana, Illinois, and Missouri, based on the sale of public lands and tax exemption, had influence in the opposite direction. In conformity with a Senate resolution adopted in 1839, the Secretary of War made a report in 1840 estimating the expense of completing the Cumberland Road as follows: in Ohio, $638,166.25; in Indiana, $3,144,250.21; in Illinois $2,448,838.52; in Missouri, $1,664,740.45, making a total of $7,896,046.44,[2] a sum in excess of the amount that had been appropriated by Congress up to that time. The fact that so large a sum was required to complete the road was perhaps the principal consideration which led Congress to abandon this great national project, but it was far from the only argument.

The controversy which waged over states' rights up to the time of the Civil War was always a factor in the National Road discussions. To what extent should the construction and maintenance of highways be a state and not a national problem?

[1] *Ibid.*, p. 28.

[2] *Ibid.*, pp. 94–95.

Should the federal government do more than appropriate money and require the states to comply with certain standard plans and specifications? These are debatable and very important questions at the present time, as they were historical problems of the days of Jefferson, Madison, Monroe, and Jackson. Should eminent domain be vested in the state or nation? If in both, where should the line of demarcation be drawn? Consider the question of the tolls that were provided for in the famous bill which was vetoed by President Monroe. If federal agents were to collect tolls, perhaps in the state of Maryland, and exercise full rights of eminent domain, including police powers, which would be necessary for the proper administration of the toll question, what would become of the sovereignty of that commonwealth under our dual system of government? These are questions which are as vital today as in 1822, when Monroe submitted his veto to Congress.

It must be remembered that the Cumberland Road was constructed only after the definite and formal consent of the legislatures of the states of Maryland, Pennsylvania, Ohio, Indiana and Illinois, through which it passed, had been given. In the beginning, Jefferson took no steps toward construction work without the approval of Maryland and Pennsylvania, and the consent of the latter state was given on condition that the route as originally planned should be changed to go through Brownsville and Washington. Toward the close of the period under consideration, Illinois coupled her consent to construction with the demand that the road should cross the Mississippi River at Alton. From first to last, 1806–1856, states' rights with special reference to eminent domain and the exercise of necessary police powers was a live issue, and one which tended to convince Congress that the road as a national improvement should be abandoned.

An important new factor had been introduced into the problem because the railroad, which had its beginning with the breaking of ground for the Chesapeake and Ohio Railway, July 4, 1828, was gradually but certainly proving its superiority over the highway for traffic not of a distinctly local character. When the Illinois legislature in 1844 memorialized Congress to extend the road to Alton, and in 1847 the Senate Committee on Roads and Highways recommended that the Mississippi crossing be located at Alton and not at St. Louis, Congress declined to adopt the

recommendation, not because of opposition "to the Illinois doctrine of state consent and eminent domain, but because railroads were superseding wagon roads."[1] In 1840 John C. Calhoun stated in the Senate that the Cumberland Road had cost $18,000 a mile, while Georgia at that time was constructing a railroad for $15,000 a mile. As early as 1836 New York abandoned a plan to aid a southern highway and voted $3,000,000 as a loan in favor of the New York and Erie Railroad. Similar loans were made to other railroads. In the New England States aid was also voted and "nearly forty railroads were incorporated between 1829 and 1837."[2]

By 1840, railroads ceased to be regarded as merely connecting links for inland water courses, and a period of railroad construction and consolidation began which soon resulted in a through line from New York to Chicago. Indeed by 1855 a railroad had reached Rock Island, Illinois, and in 1856—the year the Cumberland Road was completely abandoned to the states—construction had been pushed to Iowa City, Iowa, and was destined to reach San Francisco *via* the Union Pacific in 1869. In the meantime Maryland and Pennsylvania accepted full jurisdiction over the National Road within their borders in 1835. The same was true of Virginia at about the same date. West of the river the surrender was made to the states as follows: Ohio, 1836; Indiana, 1848; and Illinois, 1856; thus bringing to a close a half-century of eventful history.

For the next 40 years or more, highway work was given over very largely to the counties, townships, and even smaller units of local government. Highway administration was destined to pass from the plan of national and state centralization that existed prior to the era of railroads, through decentralization to county, township, and subordinate road district control in the horse-drawn traffic era, and back again to national and state centralization in the motor era, thus completing an instructive cycle of historical evolution.

OTHER NATIONAL HIGHWAYS

For military purposes and in order to facilitate communication with newly made settlements, a great many roads were opened up and partially improved by the federal government during

[1] *Ibid.*, p. 46.

[2] MacDonald's "Jacksonian Democracy," p. 270.

the early decades of the nineteenth century. This subject is adequately presented by Meyer in his "History of Transportation in the United States before 1860." Table III gives dates of acts, designations of roads, and amounts appropriated by Congress.[1]

TABLE III.—APPROPRIATIONS MADE BY FEDERAL GOVERNMENT FOR ROAD CONSTRUCTION

Date of acts	Designation of roads	Amount appropriated	Amount applied	Amount not applied carried to surplus fund	Balance remaining to be applied
1806, Apr. 21, 1809, Feb. 17, June 28.	Opening a road from the frontier to Georgia to New Orleans	$13,800.00	$5,500.00	$8,300.00	
June 28.	Opening roads through the territory lately ceded by Indians to the United States from the Mississippi to the Ohio and to the former Indian boundary line, which was established by the treaty of Greenville	7,800.48	5,539.35	2,261.13	
	Opening a road from Nashville in the state of Tennessee, to Natchez in the Mississippi Territory	9,000.00	3,000.00	6,000.00	
1811, Dec. 12.	Surveying and making roads within the state of Ohio, as contemplated by the treaty of Brownstone	6,000.00	5,945.50	54.50	
1812, Jan. 8.	Roads from the line established by the treaty of Greenville to the North Bend in the state of Ohio	800.00	.....	800.00	
1816, Apr. 27, Apr. 27.	Roads in Illinois Territory	8,000.00	1,208.51	.....	$6,791.49
	Roads between Columbia, Tennessee, and Madisonville, Louisiana, and Fort Hawkins, Georgia, and Fort Stoddart	10,000.00	10,000.00		
1817	Opening a road from Reynoldsburg on the Tennessee River, in the State of Tennessee, through the Chickasaw Nation to intersect the Natchez Road near the south end of Chickasaw Oldtown	4,000.00	4,000.00		
	Total		$35,193.36		

Land Grants. From 1823 to 1869 Congress followed the policy of making land grants for the opening of wagon roads in much the same manner that similar grants on a much larger

[1] MEYER, "History of Transportation in the United States before 1860," pp. 31–37.

scale were made to railroads. These grants, as a general rule, contained provisions for administration and stipulated that the traffic of the government should be free from toll. Table IV shows the roads, the states receiving the grants, dates and amounts of the grants in acres, the total being 3,276,646.21 acres.[1]

TABLE IV.—LAND GRANTS FOR ROAD SUBSIDIES

The road	State receiving grant	Date of grant	Acres granted
From Lake Erie to Connecticut Western Reserve	Ohio	1823	80,773.54
From Lake Michigan to Ohio River	Indiana	1827	170,580.24
From Ft. Wilkins, Copper Harbor, Mich., to Green Bay, Wisconsin.	Michigan and Wisconsin	1863	302,930.96
From Ft. Wilkins, Copper Harbor, Mich., to Wisconsin State Line.	Michigan and Wisconsin	1863	221,013.35
Oregon Central Military Co. (Now California & Oregon Land Co.).	Oregon	1864	859,937.29
Corvallis and Yaquina Bay	Oregon	1856	83,716.76
Willamette Valley and Cascade Mountains	Oregon	1866	861,511.86
Dalles Military Road	Oregon	1867	590,942.10
Coos Bay Military Road	Oregon	1869	105,240.11
Total			3,276,646.21

LOCAL CONTROL

When Charles Dickens visited America in 1842, he had occasion to travel by stagecoach from Cleveland to Sandusky, Ohio. The condition of a great many public roads of that day, under a system of local administration, was very graphically described by Mr. Dickens in the following terms:

It was well for us that we were in this humor, for the road we went over that day was certainly enough to have shaken tempers that were not resolutely at Set Fair, down to some inches below Stormy. At one time we were all flung together in a heap at the bottom of the coach, and at another we were crushing our heads against the roof. Now, one side was down deep in the mire, and we were holding on to the other. Now, the coach was lying on the tails of the two wheelers; and now it

[1] HIBBARD, "A History of the Public Land Policies," p. 236.

was rearing up in the air, in a frantic state, with all four horses standing on the top of an insurmountable eminence, looking coolly back at it, as though they would say "Unharness us. It can't be done." The drivers on these roads, who certainly get over the ground in a manner which is quite miraculous, so twist and turn the team about in forcing a passage, corkscrew fashion, through the bogs and swamps, that it was quite a common circumstance on looking out of the window, to see the coachman with the ends of a pair of reins in his hands, apparently driving nothing, or playing at horses, and the leaders staring at one unexpectedly from the back of the coach, as if they had some idea of getting up behind. A great portion of the way was over what is called a corduroy road, which is made by throwing trunks of trees into a marsh, and leaving them to settle there. The very slightest of the jolts with which the ponderous carriage fell from log to log, was enough, it seemed, to have dislocated all the bones in the human body. It would be impossible to experience a similar set of sensations, in any other circumstances, unless perhaps in attempting to go up to the top of St. Paul's in an omnibus. Never, never once, that day, was the coach in any position, attitude, or kind of motion to which we are accustomed in coaches. Never did it make the smallest approach to one's experience of the proceedings of any sort of vehicle that goes on wheels.[1]

The first articles of a scientific character dealing with public roads which appeared during this time were one by Mr. French entitled, "Country Roads," 1866, and another by Mr. Dodge, entitled, "Country Roads and Road Laws," 1868."[2] Mr. French discusses the location of roads, selection of the proper route, and the construction of roads with due regard to proper foundation, drainage, and material used. The merits of the so-called macadam road as compared with that constructed on the Telford plan are considered in some detail. The article has much in it of value from the standpoint of a practical road builder. One of the most important suggestions made is that the system of election of surveyors at town meetings, and of receiving labor in lieu of money for road taxes should be abolished, and a competent roadmaster appointed for each town and held responsible for maintaining the roads in good condition, being given authority to employ the necessary labor and expend the money for that purpose. Needless to say, these ideas were much in advance of the time, as it required another generation

[1] Works of Charles Dickens, Library *Ed.* "Pictures from Italy; and American Notes," pp. 378–379.

[2] *Report of the U. S. Commissioner of Agriculture,* 1866, pp. 538–567; and *Report of the U. S. Commissioner of Agriculture,* 186, pp. 3848–366.

to make even a good beginning of the development which finally ended in abolishing labor taxes and providing for the payment of road taxes in money.

In his article published in 1868, Mr. Dodge also condemns the system of levying road taxes in labor, and states that so long as this plan is continued poor roads will be the inevitable consequence. The labor system, he states, had been a failure for more than 200 years for reasons inherent in the plan itself; hence, a reform was greatly needed. Plank roads are condemned on account of their high cost of construction, as well as for their lack of durability. A critical discussion is made of materials of road construction, such as earth, stone, and gravel. While the country road tax at this time was for the most part paid in labor, the bridge taxes were usually paid in money being levied on all taxable property in the rural districts. The method of electing road supervisors, regardless of qualifications or fitness for the work, it is suggested, is everywhere acknowledged to be very defective and unprofitable in its results.

The general conclusions of this study of highway administration were at least a generation in advance of the time. The following quotation is illustrative:

> All money required to construct and maintain the roads and bridges in each county should be raised by levying a tax in money. A competent county road engineer should be permanently employed, who should have the entire direction of all construction and repairs of roads and bridges in his district, with the power to draw on the treasury for the necessary means to meet all reasonable requirement in defraying the cost of the work to be executed.[1]

A great many states did not provide for the county road engineer with this power and authority for another half-century.

The reasons for the continuance of bad roads and the slow development of improved methods of highway administration during the period under consideration may be summarized as follows: The excellence of the railway system and the extensive waterways; long familiarity with bad roads and the indifference of the public generally and especially highway officials; the lack of appreciation of the social, commercial, and economic value of good roads and the fear of increased taxation, especially on the part of the farmers; the wasteful and inefficient system of payment of road taxes in labor; and finally, very meager general

[1] *Ibid.*, pp. 364–365.

knowledge of the practical necessity of good business methods in highway construction and maintenance. All of these had to be overcome before a modern system of highway finance and administration was possible.

Ideas of Coleman and Rusk.—The growing importance of public highways and the general condition which prevailed just prior to the creation of the Office of Road Inquiry in 1893 are well stated by Mr. Coleman, United States Commissioner of Agriculture, in his report for 1888. In 1892 the Secretary of Agriculture, Mr. Rusk, called attention to the fact that the experiment stations and agricultural colleges were admirably fitted to lead public sentiment for better methods of road construction and maintenance. The stations, it was suggested, should study methods of road making, experiment with machinery, and determine the fitness of different forms of vehicles for different roads. Colleges, he said, should offer courses in road engineering, and assist in educating the public in the art of good road building.

BUREAU OF PUBLIC ROADS

The Appropriation of 1893.—On Mar. 3, 1893, an appropriation was authorized by Congress which again brought the national government into direct touch with problems of highway administration. The modest sum of $10,000 was appropriated to enable the Secretary of Agriculture to make inquiries in regard to the systems of road management throughout the United States, investigate the best methods of road building, prepare publications suitable for distribution, and assist the agricultural colleges and experiment stations in disseminating information on the subject of public highways.[1]

Acting on the authority thus vested in him, Mr. Morton, Secretary of Agriculture, appointed Roy Stone as Special Agent and Engineer for Road Inquiry, and gave him general instructions regarding his duties. Among these duties are listed the compilation of the road laws of the various states, investigation of the systems of road management and the methods of road construction and maintenance, the publication of bulletins, and cooperation with the agricultural colleges and experiment stations in disseminating information regarding public highways. Special instructions were given to investigate materials of con-

[1] "United States Statutes at Large," vol. 27, p. 737.

struction, such as earth roads, gravel, and macadam, including the cost of transportation of material for the proper surfacing of roads.

Mr. Stone.—In conformity with these instructions, Mr. Stone sent letters of inquiry to the governors of all the states and territories, members of Congress, state geologists, and railroad presidents. In these letters attention was directed to the fact that through the Department of State valuable data had been collected regarding foreign roads and road making, and he expressed the hope that similar data from the different states might be collected through the cooperation of various public and private sources of information. For example, state geologists possessed special knowledge of road materials, while railroad presidents were informed as to rates, including such reduced rates as might make possible the shipment of permanent road material a distance of 100 or possibly even 200 miles.

From the beginning of its history the Bureau of Public Roads, which was known at first as the Office of Road Inquiry, has given a large amount of its energy to educational work. Education in the good-roads movement was conducted by conventions, road congresses, good-roads trains, and other efforts of a similar character. Following this, the education of the people was by the demonstration method, or the building of sample roads either as model roads or as experimental roads in various parts of the United States. Other phases of educational work consisted of advice given not only respecting technical problems of highway construction and maintenance but also certain economic and financial problems. Finally, one of the most useful types of educational work for the benefit of public highways carried on by the Bureau of Public Roads has been in the field of research. This research has been directed along technical lines, in the general field of highway administration, and in the economic and social advantages of good roads.[1]

[1] For additional details regarding the organization of the Bureau of Public Roads, see "The Bureau of Public Roads," Institute for Government Research, Service Monographs of the United States Government, 26.

CHAPTER II

HISTORY OF STATE AND LOCAL HIGHWAY ADMINISTRATION

The hardy pioneers, who first settled in this country, at Jamestown in 1607 and Plymouth in 1620, naturally brought with them the political, social, and economic institutions of the mother land. Among these were that love of civil and religious liberty that is so sacred an heritage of the Anglo-Saxon, and the desire to govern themselves through popular assemblies and to enjoy other privileges of a similar nature handed down from the days of Magna Charta. Whether the famous town meeting, as it developed in New England, and county organization, as it developed in Virginia, were brought from the mother country, or were indigenous to the virgin soil of a frontier civilization, is a question of historical interest but one upon which learned historians are sure to disagree.

The ideal of free institutions undoubtedly came from England, but its conception has been traced by able historical scholars to the forests of ancient Germany. The various and changing forms, through which this ideal found expression on the new continent, were largely a product of the frontier in American history, a frontier which advanced slowly but irresistibly from the coastal plain to the Piedmont lands of Thomas Jefferson. In the century that followed, it pushed through the passes of the Appalachian Mountains to the soil that nurtured Henry Clay and Andrew Jackson, later to the very center of the great Mississippi Valley, which produced Abraham Lincoln, and finally to the broad expansive Western prairies so typical of the spirit of Theodore Roosevelt.

LOCAL GOVERNMENT

Three clearly defined types of local government developed in colonial times. These were the county; the town, generally known west of New England as the township; and a compromise combination of these plans. The compromise plan may be called

county-township where the emphasis is on the county unit; and township-county where the township happens to be the more important form of local organization. Such modifications of these three types as the hundred, somewhat resembling the county, as it developed in Maryland, and the parish as it exists in Louisiana, should be mentioned. Likewise, following English custom, the borough early developed as a community chartered by the colonial governor, as the representative of the Crown. Various colonial towns received such charters, thus becoming boroughs receiving a system of administration somewhat different from that of the town. New York and Albany received such charters in 1686, Philadelphia in 1691, Annapolis in 1696, Richmond in 1742, and Trenton in 1746.

The importance of all these units of local government is reflected in the travail that has always attended efforts to provide adequate solutions for the problems of highway finance and administration.

Virginia.—The earliest road laws of which a record has been discovered by the authors were adopted in Virginia not long after the landing at Jamestown. Act 50, of Hening's "Statutes at Large" reads as follows:

> Highways shall be layd out in such convenient places as are requisite accordinge as the Governor and Counsell or the commissioners for the mounthlie corts shall appoynt, or accordinge as the parishioners of every parish shall agree.[1]

Another early law "Concerning Surveyors of Highwaies" provides:

> That surveyors of highwaies and maintenance for bridges be yearly kept and appointed in each countie court respectively, and that all gennerall waies from county to county and all church waies to be laied out and cleered yeerly as each county court shall think fitt, needful and convenient, respect being had to the course used in England to that end.[2]

Maryland.—Other colonies followed the example of Virginia by enacting definite road laws. Maryland passed its first road act in 1666, although actual road building had commenced at a much earlier period. This first act required the commissioners of each county to meet in their respective counties, determine the roads that ought to be improved, and mark out the most

[1] HENING, "Statutes at Large, Laws of Virginia," p. 199, 1619–1660.

[2] *Ibid.*, p. 436.

convenient highways and paths through their county and also to make passable for "horse and foote" the heads of rivers, creeks, branches, and swamps. These commissioners were given authority to appoint road overseers. In order to make possible road work, taxes were levied and made payable in "leavy tobacco" or "labour," and heavy fines were imposed in case public officials failed to perform their duties as required by the law.[1]

Cumberland Gap.—The Appalachian chain of mountains extending from Vermont to Georgia, which had served as a protection against the French and the Indians during colonial days, became a barrier to settlement in the Ohio and Mississippi Valleys after the Revolution. In the North the natural passageway through this mountain wall was by way of the Hudson and Mohawk valleys, thence to the chain of Great Lakes. In the middle sections were the valleys of the Susquehanna and Potomac rivers and their tributaries, with a natural gateway near Pittsburgh. In the South the James River, and its tributaries, connecting with the great Shenandoah Valley, leading toward Philadelphia, forms a natural outlet through the Cumberland Gap into the fertile region of Kentucky and Tennessee.

In early times the passageway to the north through the state of New York was effectively blocked by the French and the Iroquois Indians. The same was true of the route to the South, where Indian tribes received the support of Spain, which held control of the Florida region until 1819. The opposition of the French and the Indians added to certain great natural difficulties also retarded settlement in the Ohio Valley by way of Pittsburgh. In this situation it was quite natural that the Cumberland Gap became the great historic passageway through which the early settlers poured into the blue-grass regions of Kentucky.

Wilderness Road.—In 1774–1775 Daniel Boone blazed a path from the headwaters of the Shenandoah and the James through Cumberland Gap and across Kentucky to the Falls of the Ohio at the present site of the city of Louisville. No practicable through route existed at that time between Cumberland Gap and Pittsburgh. The total distance traversed and marked out as a line of travel from Watauga to Boonesborough was over 200 miles. The Boone road led to the very heart of the blue-

[1] "Archives of Maryland," *Proc. and Acts of Maryland*, pp. 134–135, 1666–1676.

grass region. As originally marked, it was but a trail, and no vehicle of any sort passed over it until some years later when it was converted into a regular wagon road.

The historic importance of this natural highway, however, cannot be overestimated. The great immigration from 1775, the outbreak of the American Revolution, to 1795, a period of 20 years, was a movement on foot. On this point Speed writes as follows:

> Many of the accounts of the foot-travel of that day, if not authenticated beyond question, would read like fables of antiquity. Boone, in going from the settlement on Clinch River to the Ohio Falls in 1774, walked 800 miles in 62 days. He made many trips back and forth over the Wilderness Road. Taken prisoner at one time by the Indians, he escaped at Chillicothe, and fled back to Boonesborough, a distance of more than 150 miles, in 4 days. His entire life was one of constant activity; yet he never comes before the mind as a horseman; only as a hunter, an Indian fighter on foot. An equestrian statue of Daniel Boone would be as unfitting as to associate him with a locomotive.[1]

The Wilderness Road did very much to establish the power of the white man in the western country. It broke the barrier which separated the East from the West, thus dividing the Indians in the North from those in the South, operating at the same time as a flank movement on the powerful tribes of Indians which occupied New York and Pennsylvania, causing them to give way before the advance of civilization. It opened up settlements in Kentucky, Tennessee, Ohio, Indiana, and Illinois, thus making possible one of the great major steps in the westward movement of American population.

IOWA

The processes of education, promotion, and legislation that have influenced highway administration during the last half-century, and particularly during the period since 1890, can be best illustrated by a summary of the events in each of several typical states. While a certain similarity exists in the trend of events thus depicted, the rate of progress and the nature of the legislation that has been enacted has an individuality that partakes of the characteristics of the population of the state.

[1] SPEED, "The Wilderness Road," p. 44.

Illustrations of this character might be repeated until each state history had been recounted, but the purpose is not one of historical record; rather, one of emphasizing that legislatures rarely provide for new ventures in public improvements until they are certain that a strong demand exists, and that in any event it takes years of steady pressure to bring about reforms in public administration.

Good-roads Movement.—The good-roads movement in Iowa may be said to date from a State Road Convention held at Iowa City in 1883. For the first time in the history of Iowa, road improvement was discussed from the standpoint of political, economic, and engineering science. The convention did not stop with mere discussion, but endorsed the following propositions: (1) the payment of property road taxes in money; (2) the appointment of a township road superintendent or road master for at least a part of the year, thus substituting the civil township for the small road district as a unit of actual road administration; and (3) the establishment of a county road fund, which meant that the county should be clearly differentiated from the township and made a distinct and important unit of local government for the supervision and control of highways.

As a logical result of the good roads agitation, an act to promote the improvement of highways was passed in 1884, which provided that the county board of supervisors "may" levy a tax to create a county road fund; and the township trustees "may" consolidate the several road districts of their township into one highway district; they "may" order the township highway tax to be paid in money; and finally, they "may" let work by contract "to the lowest responsible bidder." The word "may" was used instead of "shall," because of the violent opposition in the rural districts; but the measure, although purely optional in character, served as an entering wedge for development along the right lines.

Act of 1902.—The progress really made during the period from 1883 to 1902 was so marked that legislation was enacted in 1902 to make mandatory the reforms that were optional under the Act of 1884. The law of 1902 plainly stipulated that the township trustees "shall consolidate said township into one road district"; that all road funds belonging to the road districts of a certain township "shall" become a general township road fund; and that the township trustees "shall" order the township

road tax paid in money. Thus, the subdistrict system was finally abolished and the civil township made the basis of actual road supervision.

The levy of a tax by the county board of supervisors to create a regular county road fund was made mandatory by the provisions of an act passed in 1894.

State Highway Commission.—The leaders in the good-roads movement, however, made continued efforts to overcome the forces of opposition that were so active during the years from 1904 to 1912. The 1904 session of the General Assembly not only defeated the strenuous effort made to return to the subdistrict system, but it took a most important forward step by creating a State Highway Commission. At first the Commission was granted the very limited authority to collect certain data and furnish expert advice when requested to do so; but the public sentiment was not long in demanding a substantial increase in the powers of this body.

Laws of 1913.—In 1913 a law was passed which delegated greatly increased powers to the State Highway Commission. It was the intention to give the Commission authority in those road matters which cannot be efficiently administered except by the state, at the same time reserving to the township and county the largest measure of authority consistent with reasonably sound principles of highway finance and administration.

It was clearly anticipated by the members of the General Assembly, and particularly by the highways committees of both House and Senate, that the measure as placed on the statutes, would be perfected in succeeding years by the addition of the amendments, dictated by experience, to be necessary.[1]

The Commission as originally constituted was composed of three members, two of different political affiliations appointed by the governor, and the third the Dean of Engineering of Iowa State College of Agriculture and the Mechanic Arts.

Powers of Commission.—The sections of the law dealing with the authority of the Commission reads as follows:

The duties of the said commission shall be:

To devise and adopt plans of highways construction and maintenance suited to the needs of the different counties of the state, and furnish standard plans to the counties in accordance therewith.

[1] *First Annual Report of Iowa State Highway Commission*, p. 147, 1914.

To disseminate information and instruction to county supervisors and other highway officers, answer inquiries, and advise such supervisors and officers on questions pertaining to highway improvements, construction and maintenance and of reasonable prices for materials and construction.

To keep a record of all important operations of the highway commission and to annually report the same to the governor by the first day of December, which report shall be printed as a public document.

To appoint such assistants as are necessary to carry on the work of the commission, define the duties and fix the compensation of each, and terminate at will the terms of employment of all employes, provide for necessary bonds, and fix the amount of the same.

To make investigation as to conditions in any county, and to report any violation of duty, either of commission or omission, to the Attorney-General, who shall take such steps as are deemed advisable by him to correct the same.

The state highway commission shall have general supervision of the various county and township officers named in this act in the performance of the duties here enjoined, and shall have full power and authority to enforce the provisions of this act.[1]

In 1924 the Commission was given authority to make surveys, plans, and estimates of cost for the elimination of danger at railroad crossings on highways and to confer with local and railroad officials and with the Iowa Railroad Commission with reference to such elimination; assist the board of supervisors and the Attorney General in the defense of suits wherein infringement of statutes relative to highway construction is alleged; and to make surveys for the improvement of highways upon, or adjacent to, state property when requested by the board in control of said land.

Road Patrol.—Another important amendment was made requiring county boards of supervisors to cause all highways under their jurisdiction to be patrolled throughout each road-working season and for this purpose to appoint such number of patrolmen as might be necessary to perform this work. Each road patrolman was required to devote his entire time to his duties, personally inspect at least once each week all road assigned to him, drag or cause to be dragged after each rain and at such other times as might be necessary roads under his supervision, and perform other duties of a similar character necessary to

[1] "To perform all other duties required by law," *Supplement Code of Iowa*, 1913, p. 548.

keep the roads in a good passable condition. Wherever this system has been provided, the general opinion prevails that maintenance work is thereby placed on a more efficient basis. It means a financial saving not only for the taxpayers, but for all users of the highways.

Act of 1925.—Finally, the General Assembly of 1925 amended the road laws in a manner so as to fulfil entirely the requirements of the various acts of Congress with reference to federal aid. The two essential features of this amendment were: First, the Commission was given general authority and supervision over the maintenance of the primary roads outside of cities and towns and along the corporate limit lines thereof, and was instructed to cooperate with the various county boards of supervisors to provide and establish an economical policy of primary road maintenance; and second, from the allotment of the primary road fund each year, an amount was set aside equal to the amount received from the federal government as aid during that year, the same to be known as Federal Aid Road Fund to be placed under the jurisdiction of the State Highway Commission for development or construction work.

Thus, it required a period of about 40 years to bring about a reasonably modern and effective system of highway administration in Iowa. Throughout this period the road question was one of the dominant ones in state politics. The advocates of reforms were compelled to fight for every inch of ground they gained and in the legislature, acts were often passed or repeal prevented by a single vote, or two or three votes. The state has not yet reached the stage where progress on the trunk highway system is satisfactory, but the control over the secondary roads and the expenditures of the counties and townships is excellent. Probably 5 years must yet elapse before the state achieves a really satisfactory system of administration.

In this matter of efficient highway administration Iowa is no exception to the general rule. The local plan of control, following the building of railroads, became so deeply rooted in the public mind that, in the average state, at least a generation was required to work out modern systems of highway administration.

EARLY STATE-AID LAWS

While for purposes of convenience it is necessary to give certain definite dates to indicate various stages of progress in any

movement, the reader should bear in mind that such dates are relative and not in any sense fixed and rigid. Historical forces cannot be diagrammed nor, as it were, boxed up in such an artificial manner. The small beginnings of a given movement always go back earlier than any specific date which may be given. Likewise, the results, at least of any general movement, are felt for many years later than the time suggested by a given author. Take, for example, such an important subject as turnpike-toll roads. Highways of this type form the outstanding characteristics of a certain reasonably definite period of American history. The second quarter of the nineteenth century may be suggested as the climax of that particular type of road construction and maintenance; but the writer would be the first to admit that good reasons might be found for extending this date in both directions. The truth is that the beginnings of the toll road were in the latter part of the eighteenth century, and scattered roads of this kind in various sections of the country were still in existence after 1900.

Historical Forces.—Apply the same general principle to the period under consideration. In 1891, when New Jersey became the pioneer in state-aid road legislation, certain very definite historical forces which made this new movement not only possible but also practicable had been in operation for at least a generation. The conditions which still existed more than 10 years after New Jersey began the policy of state-aid legislation are well described by Mr. Richardson in the following terms:

> The road laws of the states of the Middle West as a rule follow the old-time models, with here and there special acts permitting the construction of permanent roads by petition at the cost of the owners of abutting property. In some cases enactments enable the township and the county to share with the adjoining property the cost of the construction of some special stretch of highway. Though there are such exceptions as those just noted, still the old-time slovenly and wasteful methods are in use in most of the road districts, including the old feudal method of ordering out the hands to work the roads, generally under an inexperienced and incompetent overseer. There is probably no other feature which has done so much to maintain the low state of road making as the forced-labor system. It has bred a shiftless method of work which has led our people to look upon road building as a farce. There is no situation in which the citizen makes so unsatisfactory an appearance as when he is endeavoring to make the least possible amount of labor count as a day's work on the highways of his district. Iowa by a recent law

has enlarged her road districts to the limits of her township lines, abolishing the forced-labor system, and requiring all road taxes to be paid in money.[1]

In striking contrast to this fairly accurate statement characterizing the condition of road administration which prevailed in 1903, the reader will find very instructive a statement made in 1866 by Mr. French, which reads in part as follows:

> The whole system of election of surveyors at town meetings, and receiving labor instead of money, should be abolished, and a competent roadmaster should be appointed for each town, who should be held responsible for maintaining the roads always in good condition, and who should employ the labor and expend the money necessary to do so. In a few towns in Massachusetts this plan has been adopted, with great economy and success. The method is to appoint a permanent superintendent of roads, and to purchase such oxen, horses, and implements as may be necessary, and keep them at the public expense. A small force, such as may be constantly employed to advantage, may be hired by the year, and laborers by the day or month may be added as occasion may require.
>
> The town of Waltham, ten miles from Boston, may be cited as an instance in which the plan now recommended has been fairly tested. There are in the limits of the town fifty-one miles of public ways, and for nine years they have been under the charge of the same superintendent.[2]

Mr. French was not the first, and it is quite certain will not be the last, man 50 years in advance of his time. The town of Waltham in Massachusetts recognized as early as 1855 the desirability of making the town one unit of local government for purposes of efficient highway administration, also the desirability of appointed rather than elected officials to do work of this character. Approximately a half-century later Iowa enacted a law recognizing the merit of such an administrative arrangement. The practice, however, is by no means universal even at the present time throughout the country at large.

Unequal Taxation.—The outstanding economic reason for inaugurating the policy of state aid was the inequitable plan of highway taxation which prevailed generally throughout the country in 1890. Under the system of local management of public highways which succeeded the toll system, tax burdens

[1] RICHARDSON, "Progress of Road Building in the Middle West," in "Yearbook of the U. S. Department of Agriculture," pp. 458–459, 1903.

[2] FRENCH, "Country Roads," in *Report of the U. S. Commissioner of Agriculture*, p. 562, 1866.

for road purposes rested almost entirely upon farm property. Cities generally escaped paying a road tax. This was not only unjust, but the result was inadequate revenue to construct and maintain roads and bridges of types that were becoming more and more expensive. The traffic, moreover, in its development took little or no account of township and county lines. It frequently happened, for example, that traffic from one county would destroy the roads of a neighboring county. Again, it should be observed that new traffic conditions gave rise to more difficult problems of road construction and maintenance, which the limited skill of local officials was not able to solve. Add to these considerations the fact that highway taxes were paid in labor as the usual thing, and a condition, and not a theory, resulted which rendered state action essential.

New Jersey, 1891.—To meet this situation, the state of New Jersey enacted a law providing for state aid in 1891, which law became effective in 1892. This historic measure made provision for the raising of money by township bonds for grading, macadamizing, and otherwise improving township roads; county bonds to improve certain county roads designated by the board of chosen freeholders of the county; abolition of the office of road overseer; the payment of road taxes in money; and a policy of state aid. The state-aid provision of the law reads in part as follows:

> The State shall pay one-third of all cost of road improvement so authorized by the chosen freeholders, within the limit, at present, of $75,000 per annum.
>
> Whenever the owners of two-thirds of the lands fronting on any public road will undertake to pay one-tenth of the cost of improving such road, it shall be the duty of the board of chosen freeholders to cause such improvements to be made.[1]

Thus, it is seen that in one brief law of sixteen short sections, the statute labor tax was abolished and a cooperative plan of financing highways established, embracing the state, the township, the county, and abutting property owners. Space will permit reference to only three or four other early state-aid laws.

Massachusetts, 1893.—An act to provide for the appointment of a highway commission to improve the public roads was

[1] U. S. Department of Agriculture, Office of Road Inquiry, "State Laws Relating to the Management of Roads," *Bull.* 1, p. 9, 1888–1893.

approved in Massachusetts June 19, 1893.[1] The governor, with the advice and consent of the council, was required to appoint three commissioners at a salary of $2,000 each and traveling expenses. The commission was required to compile statistics, make investigations, advise regarding construction, alteration, and maintenance of roads, prepare maps showing location of road materials, and hold a public meeting in each county for the discussion of road matters at least once a year. On petition of county commissioners, the highway commission was authorized to adopt any road as a state highway and construct the same, except that grading and bridging were required to be done at county expense. On petition, also, of two or more cities or towns, a connecting road might be made a state highway and constructed in the same manner.

Vermont.—At about the same time, Vermont created a State Highway Commission to investigate the matter of road building. A town tax of 20 cents and a state tax of 5 cents on the dollar of the so-called grand list was levied for the support of highways. The state tax was apportioned and repaid to the town according to road mileage.

New York.—The early history of state-aid legislation in New York is very instructive. On recommendation of Governor Morton, a legislative commission was appointed which made a careful investigation of the problem of state aid, including a visit to New Jersey. This was in 1893. After a somewhat strenuous campaign of education among the people at large, very comprehensive and progressive road laws were finally enacted in 1898. The Higbie-Armstrong Act was enacted for the purpose of permanently improving the main-traveled roads of the state connecting the principal centers of population and known as first-class roads. Under this act the state was required to pay 50 per cent, the county 35 per cent, and the town or abutting property owners 15 per cent of the cost of construction in accordance with plans and specifications prepared by the state engineer. The Fuller-Plank Act provided for state aid to towns which, by vote of the people, adopted the money system for the improvement, repair, and maintenance of the public highways known as second-class roads, or feeders to the main-traveled highways. The state aid in this case was 50 per cent of the

[1] *Ibid.*, pp. 17–21.

amount levied in each town, said amount being limited to one-tenth of 1 per cent of the assessed valuation of the town with the exception of a town having an assessed valuation of less than $1,000,000.

When these two laws were passed, it was intended that they should make possible a harmonious plan for the improvement, repair, and maintenance of public highways by conserving the interest of the poorer rural communities as well as the more thickly populated and prosperous communities of the state. In this connection it should be observed that there was no limitation placed on the amount of state aid that the poorer rural communities might receive, the one-tenth of 1 per cent limitation applying only to towns having an assessed valuation of $1,000,000 and over. Under the Fuller-Plant Act, town officials are called upon to care for every mile of highway by opening ditches, cleaning culverts and sluices, and repairing the same, scraping the roads and removing all loose stones once each month from the beaten track of the highways. This work, it appears, was at that time accomplished at a cost ranging from $15 to $30 per mile. More expensive road improvement in the town, however, might be provided, which, in fact, ranged all the way from $100 to $2,500 per mile.

Other States.—Following the state-aid acts of New Jersey, 1891; Massachusetts and Vermont, 1892; Connecticut and California, 1895; Maryland and New York, 1898, other states enacted laws along substantially the same lines in rapid succession. Maine adopted state aid in 1901; Rhode Island in 1902; New Hampshire and Pennsylvania in 1903; Ohio in 1904; Idaho, Michigan, Minnesota, and Washington, 1905; Virginia 1906; Arizona, Colorado, New Mexico, Utah, and West Virginia, 1909; Louisiana 1910; Alabama and Wisconsin, 1911; Oregon and Iowa in 1913. Many other states have passed quite similar laws, but with substantially less power and authority vested in the state highway department. For example, North Carolina authorized the State Geological Survey to conduct educational and research work and employ convict labor, acting in the capacity of a state highway department. Delaware provided state aid in 1903, but only one county took advantage of the law at this time. Georgia in 1908 provided for the granting of state convict labor for road improvement purposes. By 1913, in fact, only a half-dozen states Florida, Indiana, Mississippi, South Carolina,

Tennessee, and Texas—had no provision for any kind of state participation in road work.[1]

Forms of State Aid.—In 1914, Mr. Pennybacker suggested that the systems of road management then prevailing be grouped in six general classes. The first class includes those states in which the construction of all roads is more or less under state control. In the second class are found those states in which state control of road construction is limited to roads on which state funds are expended. The third class grants state aid, but allows the expenditure to be made under local control. In the fourth group highway departments have been established for educational and advisory work. The fifth class devotes the labor of convicts to road improvement, and in the last group all control of road construction is entirely local.[2]

The same writer classifies the states into four groups from the point of view of road maintenance. In the first group, control of maintenance of all roads rests with the state. In the second class, control of road maintenance is restricted to the roads on which state funds are expended for construction. In the third class, the state requires roads on which state funds have been expended to be maintained, but leaves the actual maintenance to be performed under local control and with local funds. The fourth class of states makes no provision for the maintenance of roads on which state funds have been expended.[3]

STATE AND LOCAL HIGHWAY FINANCE

Mr. Page in 1914.—In his report for 1914, Mr. Page states that plans have been made for an expert study to be begun early in the fiscal year 1915, covering the organization, methods of operation, and results accomplished by the various state highway departments, the same to be published in 1915. The report for the following year indicates that this work had been done for the New England States, New York, New Jersey, Pennsylvania, Delaware, and Kentucky, the purpose being to issue a bulletin as soon as the study had been completed for all of the state highway departments. Reference is also made in the same

[1] Dates for the creation of state aid as given above are not in all cases from original sources of information. PENNYBACKER, "State Management of Public Roads: Its Development and Trend," in "Yearbook of the U. S. Department of Agriculture," pp. 214–215, 1914.

[2] *Ibid.*, p. 217.

[3] *Ibid.*, p. 218.

report to studies begun in 1910 and completed in 1914 for the purpose of determining the economic results of road improvement in eight selected counties, the same to be published in bulletin form in 1915. The results of this study were published in 1916 under the title "Economic Surveys of County Highway Improvement," by J. E. Pennybacker and M. O. Eldridge.[1]

Other Highway Studies.—By 1915 other studies of road management in selected counties throughout the United States begun in 1914 were about 40 per cent completed, the county and township studies having been concluded in Maine, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Indiana, Missouri, Texas, and Montana. In his report for 1917, Mr. Page, speaking of the economic studies of state highway systems, writes as follows:

> The state highway studies were continued during the year. The object of these is to ascertain the character, organization, and duties of state highway departments; the class of roads to which the aid of the state is extended; the character, cost, and extent of the work done; the methods of procedure in construction and maintenance of the state and state-aid roads and bridges; the system of reports and records; and the sources, amount, and disposition of state funds applied to roads. The completion of this investigation has been delayed on account of the fact that new legislation has been enacted recently in almost all of the states, necessitating the organization of new departments in some states and in others changes in the organization and procedure, in order that the states might avail themselves of federal aid. The results will be published in a series of bulletins, the first of which, dealing with organization and procedure, is in course of preparation. Each important phase of the subject will be treated in a separate publication.[2]

Completed Study.—The study thus completed after 4 years of labor is an invaluable source of information on the subject of state and local highway finance and administration for all of the forty-eight states. There are forty-eight different varieties of highway management. The fact that in most states the business of highway administration is in large measure passed down to the county and even the township, presents a problem of great complexity and magnitude. Some systems of highway administration are relatively efficient, others very inefficient. The reason for efficiency or inefficiency, as the case may be, should

[1] U. S. Department of Agriculture, Office of Public Roads and Rural Engineering, *Bull.* 393.

[2] *Annual Reports of the U. S. Department of Agriculture*, p. 368, 1917.

therefore be understood if the vast sums raised by taxation for roads and bridges are to be wisely expended in the future.

Those desiring information in detail are referred to the articles on state highway management, procedure, and control in public roads, as noted above. Many essential facts are given for every state in the Union. The information, however, for a given state, to be accurate, should be supplemented by such historical studies as the "History of Road Legislation in Iowa." In no other way can the student in any state obtain a comprehensive grasp of the relative importance of local government in the field of highway finance and administration as compared with the authority of the state.

COUNTY AND TOWNSHIP ORGANIZATION

Reference has frequently been made to township and county government. The power and authority exercised over road and bridge problems by town, township, and county boards, and to a less extent by certain other local officials, necessarily forms much of the general analysis of the numerous road laws that have been enacted from time to time in all of our states. A more careful study should be made of the important local government phases of the highway problem.

Some Questions.—It is, therefore, not only appropriate but necessary at this time to pause a moment and attempt to answer at least a few general questions which are certain to arise regarding the fundamental nature and the proper functions of the township and county as units of local administration; and to a somewhat lesser degree the character and scope of authority over roads and bridges vested in incorporated towns or villages, boroughs, and cities. What is a county and what are its general functions? What are towns, townships, cities, and certain other administrative subdivisions organized for exercise of limited governmental functions? What is the ruling authority in a county and to what extent is this authority limited and supervised by action of the state legislature? The same questions may be asked regarding other subdivisions of local government. No one can have a very definite and clear understanding of highway problems, under modern conditions, without being able to give a reasonably comprehensive answer to these questions and several others that might be suggested.

Local Government.—A thousand years ago in England, shires somewhat larger than the average American county were in existence for the exercise of certain very definite local power and authority. These shires were divided into hundreds, a name given much later to certain local districts in Maryland, and these in turn into townships. From that day to this, a large measure of local self-government has been the just pride of English-speaking people throughout the world. Any detailed analysis of this line of thought would, of course, be unnecessary. Suffice it to say that, for historical and other reasons, the road and bridge problem through the history of the United States from colonial days has been very largely a problem of local government. Exceptions to this general rule are to be found in early national and state-aid laws and likewise during the present-day good roads movement, which began about 1891. Even these exceptions, however, on careful analysis are found to be more nominal than real. Local boards, such as township trustees, county commissioners, and city councils especially, which have direct control of about 90 per cent of our public highways, cling with great tenacity to the powers which they possess over road and bridge matters, and, on the whole, perhaps wisely so, being very reluctant to surrender much authority to a state highway commission.

Much authority in recent years has been delegated to a state board because of the technical, economic, and engineering problems involved in the construction and maintenance of so-called primary road systems connecting leading market places. In the same way, and largely for the same general reason, states are very reluctant to delegate authority over road matters to the Bureau of Public Roads at Washington, D. C. In fact, very little such authority has been delegated, or, in the judgment of the writers, will be delegated. The famous veto message of President Monroe stands today as a very good statement of the limited power of the general government in matters of road and bridge administration.

Political Balance.—The fine balance or equilibrium, constitutional, legal, and administrative, which exists between national, state, and local authority, is a most instructive and inspiring study in the field of pure political theory. Like other social, political, and economic institutions, this balance is a product of definite historical forces. Nowhere, perhaps, are the carefully

poised interrelationships between national, state, and local units of government better represented than in the spirit of mutual cooperation that now exists and is daily becoming more evident between the Bureau of Public Roads at Washington, state highway departments, and certain local officials, especially county boards of supervisors or county commissioners. This being the case, a few very general observations regarding the nature and scope of township and county government will be made.

The County.—In all the states except Louisiana, the major district for purposes of local administration is that known as the county. Louisiana is the one state organized under the civil law brought over from France. A county may be defined as one of the civil divisions of a state for judicial and political purposes, and at the same time has a quasi-corporate character for purposes of local administration. Either by constitutional or statute law, counties are usually created as bodies politic and corporate. In other words, the county possesses political and business functions. The primary functions of a county, however, are governmental in character, since it is the agent and instrumentality of the state.

Counties, in common with other subdivisions of local administration, are created by the sovereign power of the state and even may be established without the consent of the inhabitants. While the legislature ordinarily creates counties, the constitution may do so. In the state of Iowa, whose history is reasonably familiar to the writer, with but two exceptions, every county has been created by act of the general assembly. The exceptions are two counties created by the legislature of the original Territory of Wisconsin. Bearing in mind, therefore, the elementary fact that counties are creatures of state law, it follows logically that laws may be passed creating, for example, state highway departments with a substantial measure of power over the road and bridge work initiated by county boards. This not only can be done from the nature of county organization, but, from the standpoint of a well-balanced and efficient system of highway administration, ought to be done.

While counties exist in every state except Louisiana, the fact should be borne in mind that they have very different degrees of power and authority in different sections of the United States. For example, in New England, the home of the town meeting,

functions which elsewhere are usually vested in counties are performed either by towns, on the one hand, or are tranferred directly to the state, on the other. In the South, for various historical reasons, and also in the West, generally speaking, the county is by far the most important unit of local administration outside of incorporated villages and cities. In these sections, functions are performed by counties, not only in highway matters but also in the important work of assessment for purposes of taxation, which in many states are performed by civil townships. In the Middle Atlantic and North Central groups of states, the county occupies an intermediate position, the township possessing very substantial local power and authority.

The powers of counties and county officers are described by Professor Fairlie in the following terms:

> The powers and functions of counties and county officers in the main are conferred by act of the state legislatures; but in part they are of common-law origin, and in most of the states there are now constitutional provisions of more or less importance controlling this matter. The constitutional provisions are the most fundamental and overrule both older common-law customs and inconsistent statutory enactments. Subject to the constitutional provisions, the legislature can exercise full control over county affairs. It can require any public duties or functions to be performed by county officials. It can to a large extent exercise control over the property and revenue of a county, and it can validate irregular and unauthorized acts of county officers, if they do not violate constitutional provisions.[1]

The county being a creature of the state legislature, it follows logically that county boards can exercise only such powers as are expressly conferred on them by statute. No detailed analysis of these powers is appropriate or necessary in this connection. Suffice it to say that for the most part, outside of New England, the county has a measure of authority in such matters as assessment and taxation, the administration of justice, poor relief, certain limited police powers, some measure of control over election, and finally, very substantial powers with reference to the construction of public highways.

In conclusion, it should be observed that outside of cities of a substantial population, the county is the one unit of local government large enough to support a permanent official with technical

[1] FAIRLIE, "Local Government in Counties, Towns and Villages," pp. 63–64.

training and experience. This holds true not only of road problems but also in the field of assessment and taxation. For example, it is possible to have a well-trained and well-paid county engineer, able with the proper technical assistance from a state highway board to carry out a real program of road construction. The same cannot be said of the civil township. Again, in the field of assessment, it is possible to have a county assessor well qualified, who can devote all his time to the important work of assessment. Expert opinion, at least, now strongly favors such a plan, both with reference to taxation and the public highways. The public generally is rapidly reaching the same point of view.

While the county is large enough to employ permanent expert officials for certain definite purposes, the fact should not be lost sight of that with the coming of rapid motor-vehicle transportation, it is small enough to be readily accessible from the county seat of government. In this connection it is sometimes forgotten that less than a quarter-century ago, the civil township, measured in terms of the time required to travel over bad roads and by horse-drawn vehicles, was actually larger than the county is today. Add to this the present excellent telephone and convenient rural-mail service, and the average county is a very important unit of local government where the people can readily keep in direct touch with the doings of their public officials. In other words, county government means local government close to home quite as much as is the case with the civil township. These considerations have an important bearing both directly and indirectly on the complex problem of modern highway administration. The construction and maintenance of only a very limited mileage of primary roads under these conditions needs to be placed directly in the hands of the state highway department. As will be seen later, only a very small percentage of the entire road mileage is in this class.

Townships and Cities.—As part of what already has been said regarding the county applies also to townships and cities, only a brief statement need be made of these subdivisions of local administration. In New England, as already observed, for historical reasons, the town, is still the most important unit of local government outside of boroughs and cities. In fact, the town is so important that the claim is sometimes made that it has an autonomous position, having certain power and authority not expressly delegated to some other unit of government. Such an

opinion, however, cannot be successfully defended for the reason that towns have no constitutional basis for an autonomous position. The courts have held that towns, the same as counties or civil townships, are local units into which the state is divided by the legislature from time to time for political purposes and for the convenient administration of government. The famous New England town meeting is an assembly properly summoned of the qualified voters in the town, which elects officers, makes appropriations, levies taxes, and passes certain local measures regarding roads and other problems under its jurisdiction.

The civil township as it exists in the North Central group of states is a local district of much importance, but not having the authority exercised by the New England town. It is a district for purely local affairs and a subordinate agency for county and state business. Highways, poor relief, and public schools are primary matters of township concern, but in even these cases the county frequently plays an important part and in some cases the most important part. Sometimes, the government of a civil township is in the hands of a head officer known as a supervisor, as in New York; or a town chairman, as in Wisconsin. In other states, a committee, usually of three township trustees, exercises township authority. Township assessors, township treasurers, in a few cases, and township superintendents of roads also should be mentioned. On the whole the civil township, for purposes of road administration, is a much less important unit of local government than is the county. In the judgment of the writer, while the absolute importance of the township in road matters may slightly increase, its relative importance, with the necessity of more and more expensive types of road and bridge construction, is almost certain to decline.

Only one general fact regarding the position of the incorporated village or city in matters of road administration need be suggested. It will be recalled that even in colonial days the borough, because of dense population and more complex social problems, soon became a very important unit of local government. This general situation, in a large measure at least, has continued to the present time. Such being the case, cities and incorporated places as a rule frequently retain jurisdiction over important public highways within their boundaries after the rural sections of the same roads have been placed under the general supervision of a state highway department. In many cases this is an unfortunate

condition of affairs. In a state like Iowa, for example, for a number of years the most impassable sections of main traveled roads were to be found outside the jurisdiction of either county or state authorities and within the boundary of incorporated towns and cities. Few people stop to realize that this situation is the result of long-standing and very definite historical forces.

Iowa Road Law, 1913.—The importance of the general analysis of local government now concluded can be well illustrated by a personal experience. When the bill was being drafted by a special joint subcommittee in 1913, which resulted in the creation of the State Highway Commission of Iowa with real administrative authority, the road question was one of political controversy.

When the special subcommittee first met, discussion promptly began regarding the power and authority that ought to be vested in the proposed State Highway Commission. Quite naturally, almost everyone had a different opinion. Practically no progress was made during the first two or three sessions of the committee. The suggestion was made that, at the following session, discussion start on the powers and duties of township trustees in road matters.

About three evening sessions were devoted to this question, and at the end every member of the subcommittee was in agreement as to the essential powers which might safely be vested in the proper authorities of the civil township. Discussion then began on the county and the power and authority over road and bridge matters which should be vested in county boards of supervisors with the advice and assistance of a trained county engineer. More than a week was required definitely to settle the more important problems here involved. It is significant to observe, however, that such a settlement was made harmoniously, with the unanimous support of the membership of the committee.

With this accomplished, everyone saw clearly that, under the traffic conditions then existing, there remained an important residuum of authority which could not be wisely vested either in township trustees or the county board of supervisors. Only a very short time was now required to agree upon the general powers which everyone recognized should be delegated to the proposed State Highway Commission. At the end of about 3 weeks the first draft of the bill thus was made ready for the consideration of the full committe of each house of the general

assembly. It would be difficult to find a better example of the tenacity with which people hold, and perhaps justly, to their local government in the civil township and the county. The powers vested in the State Highway Commission were understood to be delegated powers. All powers not so delegated were jealously reserved to the township and to the county, to be exercised by township trustees and county boards of supervisors with the technical advice and assistance of a county engineer.

CHAPTER III

THE DEVELOPMENT OF HIGHWAY ADMINISTRATION

The expansion, classification, and rearrangement of highway and street systems to keep pace with the needs of traffic has been in progress for many years, but has proceeded at a greatly increased rate since the year 1910, when the self-propelled vehicle became a factor to be reckoned with. These changes in highway systems have been accompanied by readjustments of administrative methods that are far-reaching in their influence. Many of the changes in the highway systems, in fact, were made for the express purpose of bringing about changes in existing administrative organizations or methods that had failed to meet the situation. In other instances, gradual changes in the administrative system grew out of the necessity for better highways to accommodate the self-propelled vehicle. The most significant fact is that, in all the more populous nations, the building of roads by methods evolved by the pathmaster and road foreman has been superceded by the construction of systems of highways under technical supervision.

Legislative Trends: Administration of Rural Highways.—The trend of legislation in recent years in the United States has been toward the centralization of authority over many public enterprises in the state or federal government. A great many sincere people entertain serious misgivings as to the advisability of the delegation of any considerable amount of authority to appointive boards and departmental bureaus, thereby circumscribing the powers of local elective officials. There may some day be a reaction to this present trend in government, but those who are conversant with the events of the past 30 years in the field of highway administration know that there has been marked improvement in highway management accompanying the establishment of the state highway departments and the federal Bureau of Public Roads. This, despite the fact that certain objectionable practices have grown up along with the rapid centralization of highway authority.

There ultimately will be a determination of the extent to which the centralization of authority in highway matters is of public benefit. Shall the county or the state be the administrative unit, or shall the nation be one unit of administration under a bureau of the federal government? Can the weaknesses of present county and of state highway organizations which have their foundation on political soil be corrected, or must those organizations be eliminated from the scheme of highway administration and their duties assigned elsewhere in the hope of securing continuing efficiency and economy?

There has been a tendency in recent years to attempt to cure all the ills of the local administration of governmental functions by transferring authority to the federal government, although the wisdom of that policy is continually questioned. There is ever present in the body politic, a strong predilection for local control over tax expenditures. (In the county, this means county control! In the state, it means state control!) Most certainly the time has come to recognize that it is hopeless to expect the governing bodies of the township and the county to deal successfully with certain types of highway administrative problems, and it now remains to be seen whether the state can do better.

The present trend in the administration of highway affairs has been due largely to the inability of the smaller units of government to cope with the technical problems that arise in the construction of highways that are suitable for present-day highway traffic. A strictly modern highway bridge, or a really high-grade pavement, that has been constructed entirely under either county or township supervision is rarely encountered, although a few outstanding exceptions to the rule could be mentioned.

There seems to be ample evidence, however, that the state is a logical and workable unit of administration, and one that can command the requisite technical personnel. Much of the notable progress in highway engineering has come from the activities of the state highway department organizations.

Despite the very great effort the states are making to meet the highway transportation situation that has developed, and the truly remarkable progress that is being made, there is a strong undercurrent of sentiment in favor of federal supervision of the construction and maintenance of those roads that carry an appreciable amount of interstate traffic. This is directly traceable to a conviction, however erroneous it may be, that the federal govern-

ment will be able to build up the highway system more rapidly than the states, and that it should supervise any public activity that is more than state-wide in its influence. The delegation of prohibition enforcement and railway regulation to the federal government may serve as a precedent for transferring to the federal government the regulation of highway traffic and the control over highway transport rates, at least with respect to the recently established national highways. The participation of the federal government in the reclamation of arid lands and in the canalization of the Ohio and Mississippi rivers may serve as a precedent for advocating the construction of a national highway system by the federal government. Many other related questions are arising in the highway field, and it seems inevitable that the federal government will be urged to enter more largely into the management of highway affairs. The wisdom of this policy may be questioned by those in position to understand the difficulties that beset the federal bureaus, but the public seems to feel that the federal government is the epitome of all that is wise and powerful; a perfectly natural sentiment under the form of government in the United States.

Status of Existing Administrative Systems.—It has been pointed out that the classification of highways into systems, each under a designated official body, arose in part because of the failure of the officials of the smaller political units to provide adequately for the traffic on certain important routes of travel. The systems of administration that have superceded the local boards are on trial and should they fail to accomplish the development of what the public considers satisfactory highway transportation facilities, undoubtedly other schemes will be devised until the desired end is attained.

The principal reason for the failure of the original plan of highway administration by local boards lay in the inability of the system to attract men of sufficient breadth of vision and leadership to insure highway development at a pace commensurate with the requirements of the traffic of the nation. This was due to two closely related factors in the situation. The first reason was that officials were elective and therefore must depend upon the exigencies of political fortune for their tenure of office and very few really able men could be induced to enter upon a career fraught with so great uncertainty. Mediocre men, on the other hand, have been quite willing to embark upon an enterprise that

promised even temporary betterment of their conditions of life. It would be in contravention of the facts to contend that no good men seek office out of a sincere desire to render unselfish public service. There have been no small number of such men on township and county boards, and the splendid systems of highways that exist in certain counties and townships, here and there, are the tangible evidence of the public-spirited efforts of a few unusual men. Unfortunately, these instances are the rare exception rather than the rule. The exactions and the uncertainties of political office are largely responsible for the failure of the older systems of highway administration to attract really competent men.

A second reason for the failure of the older systems of highway administration is the inadequate financial return that may be expected in the smaller political units. Men of ability, who naturally wish to build a career in a field where reasonable financial return is possible, instinctively turn to those lines of endeavor where conditions are favorable to the securing of a competence and a secure tenure of service. It is financially impossible for the smaller political units to afford that opportunity, except where there happens to be a large city included in the county or township. This hardly can be the case with a township because of its size, and, consequently, most of the notable local highway developments have been in the counties.

It seems hopeless to expect any township system of administration ever to afford a real professional opportunity to ambitious men who are qualified for highway service. Such opportunities do exist in county service, especially where there is a large city in the county. The young engineer may with professional profit serve an apprenticeship in county highway work.

There is no state that cannot afford to retain the services of an administrator of proved ability to head the state highway work, and a chief engineer of the required professional attainments, paying whatever salary is demanded, and many states pursue exactly that policy. As a rule, the salaries so paid are in excess of those paid by the federal government for similar service; but, on the contrary, few states have as yet devised a means of insuring a continuing tenure of office to able men, and herein lies the great weakness of the existing systems. It is almost an axiom among the men engaged in state highway work that, eventually, they will find it necessary to leave the service because of political oppo-

sition. The outstanding need at the present time is for correction of this particular condition.

Bureaucracy.—A discussion of the trend of highway administration would be incomplete unless mention was made of those defects in centralized administration which are so common that the term "bureaucracy" has been coined as a political shibboleth. There can be no doubt that there is some tendency for public officials to become unresponsive to local needs when it appears that the sentiment of that community cannot become politically effective; but long association with public officials in highway organizations of every grade and every degree of excellence, indicates that the tendency to disregard legitimate local aspirations decreases almost directly as the size and importance of an organization. The simple fact seems to be that the greater the caliber of the men in administrative positions, the more likely fair dealing is to be the rule, regardless of the opportunity for autocratic action. Unfortunately, autocratic, narrow-minded, and even dishonest men sometimes attain positions of power and responsibility in the highway field and the acts of such men have given rise to the reluctance of the public to delegate too much authority to appointive administrative organizations. Such conditions arise, not from the normal operations of the system, but from an unwise choice of men, for which there is no sure preventative under a system of popular government.

The present trend in highway legislation, therefore, is toward centralization of authority in county boards and especially in state highway departments, with certain supervisory authority by the federal government over the work done by the states on routes that are interstate in character, and which are improved with the aid of federal funds. Possibly there will be developed at some future time a system of general supervision of the national highways by the federal government, but this is problematical, although such a system is now in operation in many countries.

The systems now employed in the United States may be considered briefly in the light of what already has been said, to indicate the conditions under which highway improvements are carried out at the present time.

Township Administration.—The more important highways traversing the township have quite generally been removed from township supervision. It will be interesting to observe the trend of events that seems destined eventually to eliminate the town-

ship official entirely from the highway administrative system or place him under rigid supervision from some competent authority.

The township is a small political unit anyway, and therefore has little to offer those who may aspire to public office. Hence, it has been found that township highway officials are usually men of little special aptitude for their responsibilities. They must deal with matters that are to some degree technical in character, and the average township official is not likely to have an understanding of these. In the layout of drainage works, the construction of bridges, culverts, and surfaced roads, and in the handling of financial matters, a considerable amount of special knowledge is required to insure the wise expenditure of public funds. Very few candidates for township office possess this knowledge, nor do those who are elected usually serve long enough to acquire it. For these reasons the laws in some states provide that certain highway work, such as the construction of bridges and culverts, or paved roads, must be supervised by the county or state officials. The township officials have only the responsibility for the care of earth roads and those with low-grade surfaces. In any case the township has only occasional need for engineering service, and the engineer can rarely secure a desirable connection with a township.

County Administration.—The administration of many public affairs is delegated to the board of county officials. Care of the poor, insane, and criminal, maintenance of the seat of county business, development of drainage projects, and the administration of certain classes of highways are typical duties of such boards. Where the county contains one or more cities of considerable size or extensive industrial development, the care of the highway is an important part of the work of the county board. Certain highways are by law assigned to the county authorities for construction and maintenance, and these are generally important arteries of commerce. Since the county is usually an important political unit, it is rather common to find that county offices attract a better class of office seekers than do those of the townships. County office moreover, is generally considered a stepping-stone toward state office. While better qualified men are usually found in the county than in the township offices, it is unusual to find, even in county offices, men competent to deal with purely or partly technical matters. Some states have recognized this by providing that the county shall employ an engineer

to supervise its road and bridge work. If the county is financially able to pay enough to secure a good man for the position of county engineer, and its officials cooperate with him after they have secured such a man, good results are obtained. There are many conspicuous examples of this having been done; but there are also endless examples of counties that have nullified the law by fixing a low salary for the county engineer and thereby being compelled to employ an incompetent or inexperienced engineer. Then, by constant bickering and hampering his work in every conceivable way, these boards have made him useless to the county. If a law requires the county to employ an engineer, that law should set up some method of selection that would insure the employment of competent men.

In various states, laws are in effect under which the highway affairs of certain populous counties are administered by a special county board of highway commissioners, whose official duty it is to supervise the construction and maintenance of the county highways. Under this system, some of the wealthier counties in various states have carried out extensive road-improvement programs in a most commendable manner. They have developed county highway organizations with competent engineering personnel, and results have been attained that are a credit to all concerned. It is unfortunate that such instances are so few in number, but the method is of advantage only in those counties in which there is a large city and, consequently, ample financial resources.

The county highway boards, general county boards, and township boards all are elective and are the epitome of the local government system in the United States.

State Highway Department.—The state highway department organization that is most favored consists of an administrative body and a technical and clerical staff.

The administrative body may consist of a single highway commissioner and his deputies, or of a board of commissioners. Good results are being obtained under both types of organization and there is probably little choice between the two, so far as effective functioning is concerned. The most common practice is for the governor of the state to appoint the administrative officers of the highway department, and the makeup of that body therefore, may be said to be political.

The state highway departments have jurisdiction over the highways definitely assigned to them by law and especially those that are improved with federal aid. The state board of commissioners, or the one commissioner, determines the highway policies to be pursued and interprets the wishes of the legislative bodies as far as possible. The actual construction activities of the department are delegated to the technical organization.

Road construction and maintenance is a continuing activity and general policies should be established and then be adhered to as long as they are sound. It becomes highly important, therefore, to insure reasonable continuity of policy and method in a state highway department.

If a single commissioner heads the organization and dominates the policies thereof, he can, and usually does, depart very widely from the practices of his predecessor, which may be a good thing or be very unwise, depending upon the conditions. If the commissioner takes council with his subordinates and is conservative in his actions, changes in policy will be introduced only when it is in the public interest to do so.

A certain type of individual not infrequently encountered in political life, when appointed to the position of state highway commissioner, seems to be coincidently endowed with a knowledge of road construction infinitely more profound than that so painstakingly acquired by generations of actual highway builders.

That type of highway commissioner is an expensive luxury for any state, but there have been all-too-frequent occurrences of such appointments.

To guard against the upheaval that results from an event of that sort, many states have adopted the board-of-commissioners plan of state highway administration. The board of commissioners is made up of three or more members and the terms of office expire in rotation, so that there are always holdover members of the board. These serve to stabilize the actions of the board and to insure that it will not disregard the experience gained from year to year.

In the makeup of such a highway commission, the non-partisan idea is often followed, by which is meant that at least two political parties are represented in the membership of the commission. Quite often there are one or more *ex-officio* members on the commission, some of whom serve continuously for many years. The

Dean of Engineering at Iowa State College has been a member of the Iowa Highway Commission since 1904.

Every state now has a state highway department of some form, organized primarily for the task of providing a state and national system of highways. In many of the states, the state highway department also assists the counties and townships with their technical problems and is accorded the leadership in all highway matters.

The form of organization of the state highway commission is prescribed by the state law, but the staff of the department is usually organized in accordance with the ideas of the executive head of the department although in doing so he must observe certain provisions of law. Consequently, there is great diversity in the highway department organizations of the several states. Laws are being changed continually and in consequence the department organization may also change. The form of organization operative at any time in a state is often the result of years of development and, so far as the technical staff is concerned, may have been determined largely by the capabilities of the personnel already in the service of the department. The ideal state highway department organization has probably not yet been attained and continued progress in highway management may be expected as the lessons of experience are recognized.

Before discussing the detailed organization of some typical highway departments, it will be well to consider what these departments are supposed to do.

Functions of State Highway Departments.—The laws creating them establish the general functions of the departments and the degree of authority and responsibility conferred. The following may be assumed to represent the principal lines of activity provided for in a good state highway act.

1. To provide or to assist in providing a system of adequately surfaced state trunk-line highways.

2. To maintain or to direct the maintenance of the state trunk-line highways.

3. To devise a financial plan for constructing and maintaining the state highways and to assist legislators in making such a plan effective.

4. To cooperate with the federal government in the expenditure of federal aid for highways.

5. To promulgate regulations relative to the use of public highways and to assist in the enforcement of the laws embodying those regulations.

6. To furnish technical advisory service to the officials of the smaller political units of the state, when such assistance is desired, and sometimes to supervise more or less in detail the work of the county and township highway officials.

7. To disseminate general information relative to highway matters in the form of general reports and particularly in the form of non-technical general publicity.

In addition to the seven major functions, there are many minor matters entrusted to the organization, but these differ so greatly in the several states that a catalogue of all of them would become quite voluminous. Suffice to say that, with one exception, these minor functions comprise but a small part of the work of the commissions concerned and have little influence on the form of organization. The exception is the collection of motor-vehicle license fees. Where this work is entrusted to the state highway department, a special bureau with a considerable personnel will be required.

Administrative Problems.—A little consideration of the functions herein outlined will indicate that the duties of the chief engineer of a state highway department are to a large extent administrative. A well-known chief engineer once remarked that 90 per cent of his work was administrative, as opposed to 10 per cent that was strictly technical. This accounts for the fact that the administrative heads of many state highway departments are men who have had no training or experience in highway construction. What is not generally recognized is that most of the administrative machinery is set up to produce and to maintain public highways, and every question of policy that comes before the administration finally resolves itself into a consideration of what action will further that primary purpose. To interpret accurately the effect of any proposed administrative action upon the major function of a department, there must be a full understanding of the technical problems involved in highway construction.

The outstanding problem of state highway administration, like that of all other departments of public administration, is to secure the efficient expenditure of public funds, and especially to insure the *wise* expenditure of such funds. To illustrate: a high-

class pavement might be built where a gravel surface would economically serve the traffic. Even though the pavement be well constructed at reasonable cost, the expenditure would not be a wise one. The contrary situation also could, and does, exist everywhere.

Efficiency of Organizations.—In existing state highway department organizations, all degrees of efficiency are represented. A few are operated frankly on the basis of expending funds where they will do the most good politically, and the surprising thing is that such a policy sometimes continues for years without complaint from the public. Other departments make a serious attempt to avoid political bias in the allocation of funds and the location of improvements and, happily, departments of this type are coming to be the dominating ones. Except that presented by the government of a large city, there is no more difficult problem in the field of public administration than that presented in state highway administration. This is due to the large sums of money under the control of the department and the ease with which these funds may be diverted to semipolitical ends. Efficiency in state highway administration is not inherent in any type of organization, but certain principles of organization are held to create a condition favorable to efficiency in the functioning of the department. In the last analysis, efficiency in any state department depends a great deal upon the determination of the chief executive of the state to insist upon the conservation of the funds expended in state work.

Continuity of Policy.—Perhaps the first consideration is to organize a department so that year after year there will be a reasonable continuity of policy in the conduct of its work. In any progressive department there will of necessity be changes in types of construction, modifications of standards of design, and revisions of financial policy, but these should be evolved gradually on a sure basis of experience or experimentation. Frequent changes in the types of construction, vacillating dealings with contractors and with subordinate officials, weak specifications, and general instability; all are accompaniments of frequent changes of personnel and inexperienced management. Waste of funds is always inevitable under these conditions.

Continuity of policy in highway administration is encouraged by any system that assures reasonable continuity of service of the personnel of the department. This may apply to the engineering

organization or to the directing body, but the best results are obtained under a system that retains good men of either class as long as they care to serve.

It has been noted that in some states the directing authority in a highway department is vested in a board made up of several appointive members and in other states is delegated to a single appointive official. If the latter method is followed and the tenure of office of the head of the department coincides with that of the governor who makes the appointment, frequent changes of policy will surely result, unless the engineering staff is continuing and has some real authority over general policies. When both the directing authority and the engineering staff have a tenure of office coincident with that of the governor, no stable policy and no real progress may be expected.

Theory of Organization.—The construction and maintenance of a state highway system, like the manufacture of steel, is a highly specialized business and huge sums of money would be saved annually if the public and its official representatives could sense that such is the case. A state highway department will disburse, or sponsor the disbursement, of sums ranging from $5,000,000 to $25,000,000 per annum, and will sometimes employ as many as 1,000 persons.

How would a typical commercial corporation organize to handle a business of that magnitude?

Probably, first of all, it would take steps to insure that some one individual was held responsible for the success of the enterprise. He might be called president, managing director, or anything else desired, but upon him would be placed the whole burden of the conduct of the details of the business. He would be subordinate only to a board of directors, made up of men who knew the business thoroughly, who would meet at stated intervals to go over the reports of the manager and to advise him in matters of broad policy.

In the highway field, the managing director may be called a commissioner, chief engineer, secretary, or anything else legislatures choose, but if the highway department is to be highly efficient that person must be, in fact, the executive head of the department, and that function never can be performed by a board. By placing full authority and responsibility in the hands of one person, there is created the only kind of management that ever has been very successful in large affairs.

Since a large percentage of the problems that arise in the highway field have to do with engineering work, a properly equipped engineer is likely to be most effective as the executive head of the system, but a good executive without engineering training will succeed if he takes advantage of the assistance his engineering staff can give him.

The advisory body should assist in establishing the broad policies to be adopted and in deciding questions of general public

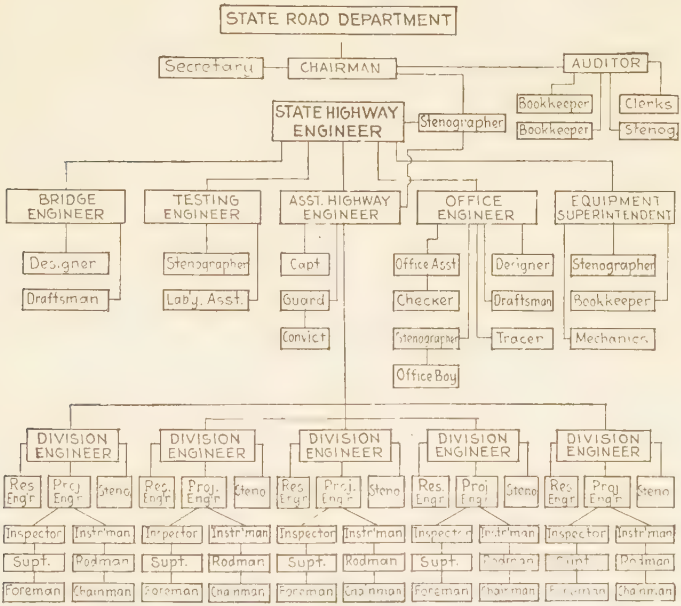

FIG. 1.—Organization of state road department of Florida.

interest. It may be made up of men of affairs who lack technical information along highway lines, but who are willing to inform themselves in regard to the economic and political considerations that arise in developing a state highway system. It is one of the anomalities of political experience that service of this kind can be more readily secured gratuitously, or for a nominal *per diem*, than it can be for hire. The proper type of man cannot drop his personal affairs entirely, but can, and will, devote the necessary time to conference with the directing authority. Such a man will serve because of a high sense of public duty and will feel adequately compensated if he receives a nominal *per diem* and

reimbursement for his actual expenses. His contacts during his ordinary business activities will give him a valuable insight into the public reaction to the various policies under consideration. An advisory board made up of such men will serve another useful purpose in that it will constitute a fairly effective buffer between the executive head of the department and those subtle and ever-present political influences that are inescapable in public service.

An advisory board of this character must of necessity retain a competent directing head, and, through him and the organization that he develops, reasonable continuity of policy will obtain.

Ideal System.—It would seem to be apparent that at the head of the state highway department there should be a governing body consisting of an advisory board of three or more members, each of whom serves for a fixed term, and an executive head of the department, employed by the governing body, who may expect to retain his position for a long term of years if his services are satisfactory. Preferably, the executive head should be a highway engineer who has had administrative experience and has shown ability in that direction.

Many states have precisely this general plan of organization. The advisory body is the highway commission upon which there may be some appointive and some *ex-officio* members; or all may be appointive. The appointments are for terms so fixed that in no one year is a majority of the commission retired. The commission or the governor appoints as the executive head a state engineer or commissioner, and he serves as long as he secures the desired results. The development of the subordinate organization is along the lines the chief engineer and commission think is best calculated to accomplish the assigned tasks with a minimum of friction, delay, and avoidance of responsibility.

Responsibility of Subordinates. "Passing the buck" became the national indoor sport during the World War. In the army itself, conditions became so bad that a war department memorandum was sent out emphasizing the need for officers who were willing to "accept the buck" instead of passing it. In any large organization there is always the tendency to avoid responsibility for mistakes or the consequences arising from the exercise of poor judgment and the opportunities for passing the responsibility to someone else are nearly always easily found. In organizations for public administration these tendencies are greatly

exaggerated and one of the first efforts of an employee who has been remiss is to fix the responsibility elsewhere.

An important consideration in building up an organization, therefore, is to fix responsibilities as far as possible. This cannot be wholly accomplished in a large organization on account of the multifarious and overlapping character of the activities, but it is possible to do so for the major lines of work. In order to fix responsibility on an individual, he must be assigned clearly understood authority, and herein lies the weakness of many

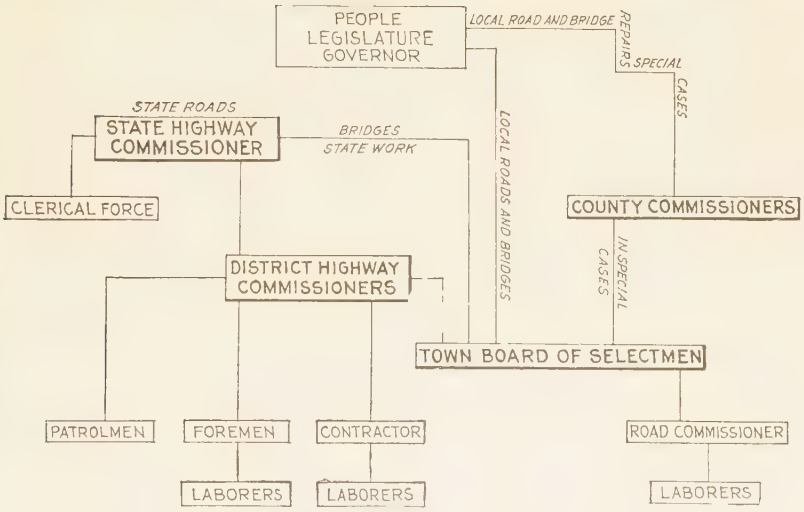

Fig. 2.—Organization of state Highway Department of Vermont.

organizations. An attempt is made to hold individuals responsible for results without allowing them an opportunity for individual initiative, and such a system is deadening. The wise administrator selects dependable subordinates and makes them supreme in their province, knowing full well that they cannot be infallible, but that under the stimulus of having a chance to establish reputations for themselves, they will be careful to avoid mistakes and give the best service of which they are capable.

Types of State Highway Department Organizations.—Several typical state highway department organizations are shown in Figs. 1 to 4, and it will be noted that little similarity exists between them. Each state has an organization that has grown

up with the progress of the highway program in the state and in accordance with the ideas of the legislatures and the leaders in

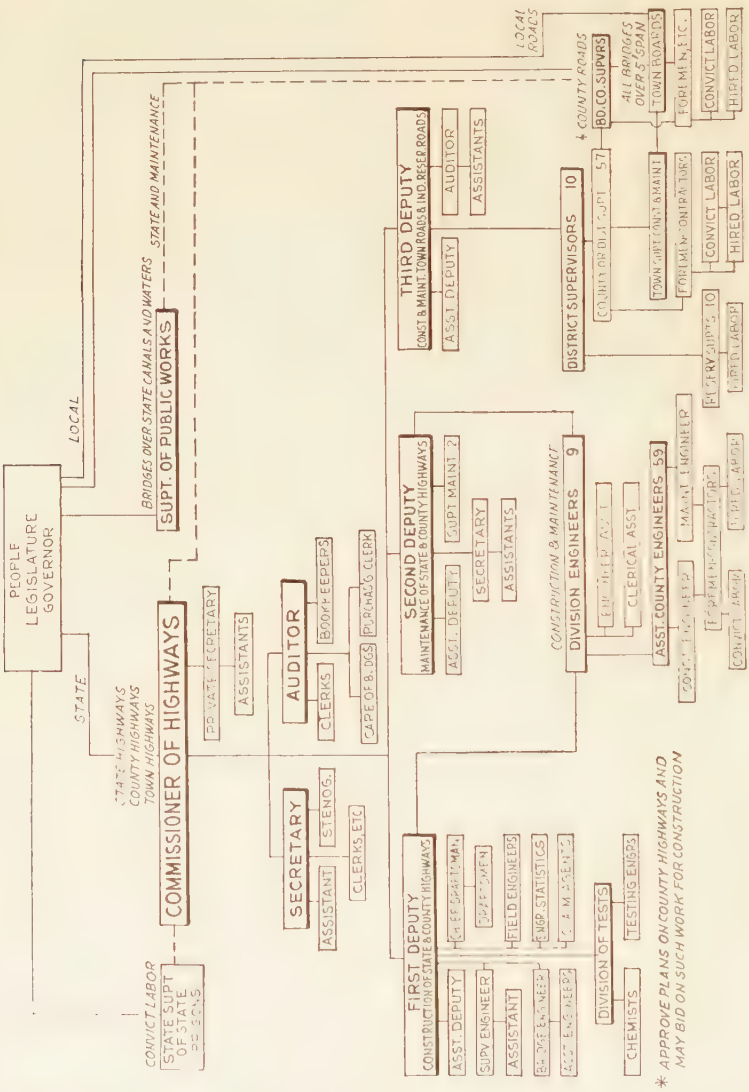

FIG. 3.— Organization of State Highway Department of New York.

the development of the state highway work. The bureau and division system is not clearly recognized in the form of organization used by many of the states, although in the actual operation

of the department the bureau idea is rather closely adhered to. This system sets up under the executive officer a bureau for each major line of work, and each bureau in turn has divisions, each of which is charged with a certain prescribed class of work.

In the organization diagram for the Texas Highway Department, it will be noted that four technical bureaus and two non-technical bureaus are provided. The technical bureaus are office (or design), testing, bridges, and road. The non-technical are auditing and clerical, and motor-vehicle registration. The divisions in the testing department are four in number as indicated, but the divisions of the other bureaus are not so apparent. It will be noted that the bureaus correspond to the kind of work performed.

A somewhat different arrangement is followed in the organization of the New York State Highway Department where three main bureaus are established in accordance with the general function of that part of the organization. Two of these bureaus have to do with activities that are controlled exclusively by the state while the third deals in part with the control of the activities of local road officials. All state work is classed as maintenance or construction, with an appropriate bureau under a deputy state highway commissioner. In the construction bureau are divisions of testing, bridges, road design, inspection, statistics, and claims.

At the other extreme is the very simple organization that suffices for the Vermont Highway System. There is no particular division into bureaus, yet this organization performs all of the functions required for a small state.

FUNCTIONS OF TECHNICAL AND CLERICAL PERSONNEL

While the major functions of all state highway departments are much alike, it has been pointed out that the volume of work to be performed and the conditions under which it will be executed, together with the provisions of the laws of the several states, have considerable influence on the exact form the technical organization takes in any state. Some of the activities of the technical staff are as follows:

Federal-aid Highways.—Under the federal-aid acts, each state must assign to its state highway department the complete supervision of the improvement and maintenance of those highways

upon which federal aid is expended. In some states this comprises about all of the responsibility of the highway department, in others it comprises but a negligible part of the business, but in every state it must be cared for. There is required for the purpose an organization to perform the following technical work:

1. Prepare project statements for securing federal aid.
2. Make surveys for highway and bridge construction.
3. Design roads and bridges on the basis of the surveys.
4. Prepare specifications and contracts following the federal standards.
5. Inspect the construction of federal-aid roads and bridges.
6. Test the materials that enter into the construction of federal-aid roads and bridges.

It is conceivable that a half-dozen engineers might perform the functions described above if the work was of limited extent; but, as the volume of work increases, the size of the staff must increase. Thus, the necessity is found for assigning the various kinds of work to bureaus of the state highway department and the work of the bureaus parceled out to divisions. The manner in which the various activities are grouped and the number of bureaus and divisions, vary according to the volume of work and the ideas of the administrative head of the department, as is shown by the highway department organization diagrams.

State Highways.—Many states have grouped their roads according to importance and have delegated to the state highway department the construction and maintenance of the state trunk-line system. Quite generally this system is also the one upon which all federal-aid construction is to be carried out. The technical work in connection with the improvement of the state trunk-line system is carried out under one or the other of two general plans. One is to delegate to each county the technical work in connection with the portion of the state trunk-line roads lying in the county except when federal aid is employed, thereby utilizing the services of the county highway engineer for the state road work under supervision of representatives of the state department. This system is employed in several states.

The other method is to perform all of the engineering and supervisory work in connection with improvements of the state road system by forces of the state highway department.

In most of the states the actual construction is carried out by contracts awarded on competitive bids.

It will be apparent that the type of technical organization that would be used for the supervision of federal-aid road work would also serve for state road work, but that, with the present federal-aid law, the county organization could not be employed on federal work unless the county engineer was really a part of the state highway department organization. There is a growing feeling on the part of the state highway officials that it is best to employ the state highway department organization for the construction and maintenance of the state road system. Under favorable conditions, the county organization may be used for the maintenance of state roads if that seems to meet the needs of the situation, and this is particularly convenient in a state of large area.

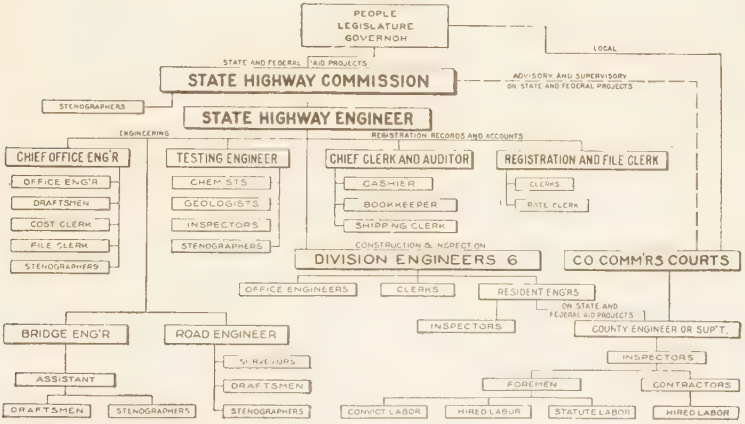

FIG. 4.—Organization of State Highway Department of Texas.

State-aid Highways.—Some states grant financial aid to the counties to assist in improving certain classes of county roads and likewise to the townships where that is the local unit of road management. The technical work in connection with state-aid roads is usually performed by engineers employed by the local boards; but the plans and specifications are subject to the approval of the state highway department. Likewise, the contracts for construction must be approved by the state and the inspection and testing are subject to the supervision of the state. It is a rule throughout the highway administrative field that any governmental unit that disburses funds must retain the privilege of approving the character of the work performed with the funds.

Association of State Highway Officials.—A certain uniformity in policies and practices in highway construction is secured through the voluntary national organization known as the American Association of State Highway Officials. This organization is made up of the executive officers and chief engineers of all state highway departments that care to become members of the association. A number of committees have been appointed by the Association to deal with technical subjects, and the reports of these committees embody the ideas of the departments as to the best practice with respect to highway construction and maintenance. The association has been a powerful and constructive agency and while its recommendations are not mandatory on its members, the state highway departments have found it wise to accept, at least in substance, the standards proposed by the committees of the association. The Bureau of Public Roads has been instrumental in securing the adoption of many of the standards proposed by the association by requiring federal-aid road plans to be prepared in conformity therewith. This association has played an important part in the unifying of the state practices with respect to highway design.

FEDERAL BUREAU OF PUBLIC ROADS

Federal aid for highways is provided by congressional appropriations to the United States Department of Agriculture and is administered through the Bureau of Public Roads of the Department of Agriculture. The major functions of the Bureau are:

1. To administer the distribution of federal aid for highways.
2. To conduct scientific research on subjects related to highway improvement.
3. To collect and disseminate information on the subject of highway improvement.
4. To construct roads in the national forests.

In order to accomplish these purposes the Bureau has the following divisions:

1. Highway design, including bridges.
2. Legal.
3. Highway construction.
4. Tests and investigations.
5. Economics.
6. Publications.
7. Accounts (control).

The duties of each division of the Bureau are numerous and vary somewhat from time to time, but in the main are as follows:

Division of Design.—This division determines the standards of design to be applied to federal-aid roads, and reviews and, when satisfactory, approves the plans for federal-aid roads as they are submitted by the state highway departments. It is constantly in touch with all researches that have a bearing on road design and keeps design standards revised to meet the requirements of changing traffic conditions. The division is represented on the committee on design that has been established by the Association of State Highway Departments and thus wields an influence on road design throughout the United States.

Legal Division.—This division is necessary to insure that the acts of the Bureau and the dealings with the states are kept within the statutes. It also handles all legal questions arising in connection with contracts, controversies, and claims against the Bureau.

Division of Construction.—The construction division supervises the construction of federal-aid roads. The contracts are awarded by the state highway departments and the inspection is provided by the state. The division of construction of the Bureau of Public Roads checks up on the character of the inspection provided by the states and attempts to insure adequate inspection and a high degree of excellence in the construction. It investigates construction methods and equipment and keeps the state informed of the progress in methods and equipment.

Division of Tests.—This division has two distinct functions. The first is to correlate the testing methods employed by the various state highway department laboratories for materials that are to be used for federal-aid roads and to make routine or special tests of materials submitted by public officials. The second function is to conduct research on subjects related to the construction of roads and bridges. In this latter capacity a large volume of most excellent work has been carried out and important investigations of many kinds are under way at all times. The results are published in the journal, *Public Roads*, in United States Department of Agriculture bulletins, and in the technical press.

Division of Economics.—The function of this division is to assemble and disseminate information on the economic aspects of highway improvement. It deals with such subjects as highway finance, taxation for road improvement, effect of road

improvement on cost of transportation, and similar problems of highway economics.

Division of Publications.—The Bureau issues two types of publications. One is a journal that is issued monthly for the purpose of informing road authorities of the activities of various divisions of the Bureau and to present reports of researches completed or in progress. This journal has proved to be of great value to the highway departments of cities and states. The other type of publication is the Department bulletin or circular which presents in a formal way the results of research and investigation. Publications of both types are edited and printed under the direction of the Division of Publications.

Division of Accounts.—All fiscal transactions of the Bureau are handled through this division, including payment of salaries and bills and reimbursement of states on account of federal aid for roads.

Division Engineers.—The Bureau of Public Roads, like the states, has found it desirable to secure contact with the state highway departments through division engineers of whom there are at present twelve. Each of these has a sufficient office force to enable them to review plans, specifications, and estimates submitted by the states in connection with federal aid, before these go to the Washington office for approval. The district engineers spend most of their time in the field, visiting construction work and conferring with the officials of the state highway departments. In addition each district office has one or more district inspectors who visit the federal-aid work periodically during construction to make sure the states are providing adequate inspection.

Securing Federal Aid. Appropriations for federal aid are made by congress from time to time and the sums so appropriated are allotted to the states on the following basis: One-third of the total appropriation is allotted in proportion to the mileage of post roads (rural delivery routes) in the state as computed by the United States Post Office Department, one-third in proportion to the area of the state, and one-third in proportion to the population of the state. After the allottment is made, the states have a period of 2 years (or as provided by congress) in which to accept it. The funds are not given outright to the states, but are paid out on reimbursement vouchers to cover payments the states have made for the construction of federal-

aid roads. Acceptance of federal aid is accomplished by filing with the Bureau of Public Roads an application for federal aid on a specific improvement project. If this application is approved by the Bureau, a project agreement is entered into in which the amount of federal aid is stipulated. When that project is completed, the state bills the United States government for the amount of federal aid due and payment is made to the state treasury. Generally, the contractor has long since been paid in full for the work.

The first step in securing federal aid, therefore, is to make application by filing with the Bureau of Public Roads a federal-aid project statement. This is reviewed by the district engineer concerned and, if satisfactory, is approved and forwarded to the Washington office where it is again reviewed. If satisfactory here, it is approved by the chief of the Bureau and becomes a project agreement. It may be returned for amendment or may be rejected altogether. Each state has been required to file with the Bureau a map showing the roads upon which that state proposes to prosecute improvements with federal aid. These maps show two classes of roads, one class which constitutes a part of the national highway system and one which constitutes a limited state system. Federal-aid projects must be a part of one of these groups of roads and at least 60 per cent of all federal aid must be expended on roads that are a part of the national highway system.

After a project agreement for federal aid has been executed, surveys, plans, and specifications for the proposed improvement are completed by the state highway department. These are forwarded to the district office for review and are finally approved by the director of the Bureau of Public Roads. The state calls for bids, awards the contract, supervises the construction, and finally approves and accepts the work. Meanwhile, the division engineers and inspectors of the Bureau of Public Roads have been in constant touch with the work, and if there has been laxness on the part of the state, the Bureau may withhold payment of the federal aid even though the project was covered by a project agreement. The whole system of federal aid is well calculated to enforce high standards of engineering in connection with the construction of roads and the system has been instrumental in bringing about a very great improvement in standards of road construction.

CHAPTER IV

THE DEVELOPMENT OF HIGHWAY SYSTEMS

There has been presented in considerable detail the history of road legislation in the United States to show the stages by which the nation has progressed from the most primitive roads of colonial times to the carefully classified system of county, state, and national roads of 1925. A brief resumé of the rise of local management of roads will be given before discussing the influences that contributed to the rather complete transformation that has taken place in the highway system since 1900.

Origin of Township Administration.—On account of the poverty of the country during the pioneer era, it was not possible to provide funds for hiring road workers and the custom arose of depending upon the voluntary labor of the residents for performing such road repair work as was indispensable. Naturally, this was road building of the crudest type on highways that were of purely local concern, which could best be supervised by the town (township) officials. As trade and commerce expanded, the citizens of the towns found it decidedly inconvenient to spend time repairing roads. Some who lived in the rural districts were not available for the performance of road work during certain parts of the year. To meet the situation, a small cash road tax was levied which was remitted to those who performed the allotted number of days (usually two) of road work each year. Those who did not care to work on the roads were permitted to commute the tax by hiring substitutes, and those failing to take advantage of commutation were to pay in cash along with the other taxes. This system involved keeping accounts, sending notices to appear to work on the roads and similar administrative duties. It was quite natural that these should be placed upon the town (or township) officials, who had been already assigned the supervision of the work performed as a result of the labor tax.

There are many states that still attempt to utilize the labor-tax system, although its inadequacy has been apparent for many years.

Origin of County Administration.—As the population spread away from the settlements and commerce began to be a real factor in community life, certain roads became the arteries of communication for considerable areas. The state of repair of these highways was of more than local concern. Settlers from several adjacent townships were compelled to use some of the roads, and if the portion in any one township was not well kept the people outside that township might be seriously hampered yet they had no adequate recourse. The item of expense most difficult for the township to meet was the cost of bridges, and so it was to be expected that stream crossings were sadly neglected. It therefore was arranged that the counties pay a part of the cost of the bridges. This was instrumental in hastening the developing of continuous stretches of passable highways. but the townships were unable, even then, to maintain the roads if the traffic was considerable, and often gave up the attempt, or contented themselves with a wholly inadequate amount of work. This situation could not forever endure and there slowly developed a system of laws under which these more important roads were taken over for upkeep by the officials of the county, and thereby classification of highways had its inception. Since the methods of transportation then employed limited the trade areas of a town, it seldom happened that the roads tributary to a market did not lie within a single county.

Toll Roads.—About this time there developed that now almost forgotten transportation venture known as the toll road. The arteries of commerce that had been placed under county administration were rarely well kept, because of inadequate funds, and the traveling public was continually seeking a way to better conditions, preferably without subjecting themselves to increased tax levies. It was comparatively easy to secure a toll-road charter and many companies were organized to improve certain of the more important roads, in return for the right to collect tolls from those who traveled the road. At intervals along these roads, gates were installed and at each gate a fee was collected. These toll roads were of corduroy, plank, or broken stone, according to the local situation, and hundreds were constructed in various parts of the country. The decay of the toll road came about from a combination of events, the most important being the gradual increase in the number of railways.

Origin of State Management. The next step was logical and inevitable. Certain highways assumed unusual importance and carried a traffic that occasioned maintenance costs that were beyond the financial capacity of the county administration, wherefore the state was compelled to take over the supervision of these roads. Naturally, this condition developed first along the north Atlantic seaboard which was the most populous district, and gradually extended westward.

This brief account of the evolution from the township road system to the state system really covers a period of more than one hundred years of national life in the United States, and the last quarter-century has witnessed the major part of the development.

National Roads.—The national government early interested itself in highway construction, and its first important contribution was the construction of the old national road westward from Washington D. C., as has been noted before. The era of railway building came just as this project was being completed and halted government participation in road building for many years. The route of this first government road is followed very closely by a modern paved highway which is known as the Old National Highway and, like its predecessor, was made possible through contribution of federal funds.

During the era of railway expansion, the development of highways was neglected by the national government because it seemed that the railway was destined to serve all transportation needs. The completion of a railway line meant the growth of new market centers and changed the importance of many of the old towns. The highways that had served an area were greatly changed in importance by the location of the new towns, and by the rail accessibility of many of the older market centers.

There was no need for the federal government to interest itself in the growth of highway systems, until the advent of the self-propelled vehicle, which began to be a factor in the problem by the year 1900. Prior to this time, highway traffic had increased throughout the states east of Illinois to such an extent that hard surfacing of some sort was being constructed on many of the main roads. The work was, for the most part, supervised by township and county officials, since but a few of the states had effective state highway departments.

Then came the automobile, which was destined in a single decade to bring about a complete transformation in highway practice.

The Rise of Modern Highway Systems.—The advent of the self-propelled vehicle came at a time when the highways of township and county consisted of a heterogeneous assortment of types of surface representing inexpert attempts to secure a serviceable trackway for horse-drawn traffic. Very few highways were really good for any considerable continuous distance. Conditions in adjoining townships reflected accurately the relative abilities of the respective highway boards. Inefficiency and the wasteful expenditure of funds for roads and bridges was the rule. Hard-surfaced roads existed principally in the vicinity of the larger market centers. Some of the states had established highway departments with more or less limited authority and were attempting to secure the orderly and adequate improvement of the more important highways through cooperation with the county and township officials.

The boards of local officials were politically powerful and resisted to the utmost any seeming encroachment of the state on their authority or restrictions on their expenditures. Progress toward a connected system of surfaced roads was slow and disheartening and funds wholly inadequate.

As increasing numbers of automobiles came into use, the inadequacy of the highway systems then in existence began to be evident and it became apparent that the states needed much more comprehensive highways than could be provided under the county and township boards. Certain highways became of national importance, and many others of state-wide importance. Local roads that had been satisfactory for the horse-drawn traffic for which they were built, were deteriorating rapidly under automobile traffic.

Many plans were proposed as solutions to the problems that arose because of the new traffic. Almost frenzied efforts were made to save these roads that were disintegrating so rapidly under an ever-increasing volume of automobile traffic, with which there was beginning to be an admixture of self-propelled vehicles designed for carrying freight.

One plan that was popular for a time involved the establishment of road improvement districts with a special tax therein for the rebuilding of certain main highways. Sometimes, a

special plan of administration accompanied the establishment of these districts and, sometimes, the regularly constituted county or township officials were charged with the supervision of the improvement projects. There was little knowledge of the requirements of construction that would have reasonable durability or of the ability of the various available materials to withstand the wear of automobile traffic. Experienced highway engineers were far too few, and public officials were generally slow to adopt new methods or new materials. There gradually arose a well-defined feeling that some change in policies was necessary to meet the situation and by the year 1910 many states had taken steps to bring about a complete revision of their system of highway administration.

The new policy that was most favored, involved the establishment of an authoritative state highway department with a technical staff, classification of the highways into groups, and some semblance of a plan of progressive road improvement. The problem was being somewhat simplified by the advances in knowledge that were the result of various experiments in construction and in the utilization of materials. There was beginning to be a very optimistic spirit among good roads enthusiasts everywhere because some real progress was discernible.

Highway construction was actually getting under way on a national scale at the outbreak of the World War; but during the period when the United States was involved, all of this came to a standstill and in addition a burden of traffic was thrown on the highways that caused serious general deterioration of the existing surfaced highways. The lessons so dearly learned during this period have been exceedingly valuable and the whole trend of recent legislation and of road construction methods has been greatly influenced by the war-period experiences of the states.

The plan of administration now generally followed in the United States sets up a system of national and state highways to be improved and maintained by the state through its state highway department, a system of secondary roads under the jurisdiction of county and township officials, and supervision over the improvement of the national roads by the federal government through the regulations for the distribution of federal aid to the states.

STATE ROAD SYSTEMS

The principles that underlie the establishment of a highway system for the United States are determined by the consideration that the nation is a federation of states, each with its administrative jurisdiction defined by boundary lines that have no relation to, and little influence upon, the movement of traffic. Highway traffic is, to some small degree, interstate in character, while administration is as yet wholly intrastate. The arteries for national highway traffic, of which there is but an insignificant proportion, are those roads that connect at state boundary lines with the roads of adjacent states. Fortunately, the centers of population are so well established and the routes appropriate for long-distance travel are so clearly apparent that it has been quite obvious which state roads would carry traffic of an interstate character.

The state road systems are, for the most part, already established and are to some extent improved. The revisions that will be made in the future will be by way of correcting mistakes in the original selection or for the purpose of adding to the system as the communities develop.

Specification for a State Road System.—An adequate state road system will:

1. Connect all cities and towns that are of sufficient importance to attract other than local traffic.
2. Form logical continuations of the state roads of adjoining states.
3. Include roads that are necessary links in routes for long-distance travel.
4. Afford access to regions devoted to recreation and especially to places of natural beauty.
5. Supplement the railways as arteries of commerce.
6. Contribute to military mobility as an element of the plans for national defense.

Key Cities and Towns.—Highway traffic is predominately intercounty and intrastate in character, and the first consideration in establishing the state roads was to select the cities that should be connected by the state roads. These were the county-seat towns and, in the populous states, all cities having a population of 15,000 or more. The smaller towns in such states might be centers for a considerable volume of strictly local traffic without attracting a significant volume of intercounty traffic. It

naturally happens that many of the smaller cities lie on or near the through routes and thus can be connected into the system, but the routes were not laid out for the specific purpose of connecting these towns.

At the other extreme are the towns of 1,000 population, or even less, that are commercial centers in the sparsely settled areas of some of the states. Because of railroad facilities, certain of these small towns serve the same purpose as do cities many times as large in populous areas. The importance of the town from the traffic standpoint is not altogether a function of size; it is a question of whether traffic will flow to that city for any reason.

These divergent conditions have been taken into account by most of the states in laying out the state trunk-road system. The basic consideration is: Does the town attract any considerable volume of traffic from a distance? Small cities may do so even in densely populated areas because the city has within its confines some institution of learning or historic shrine that attracts numbers of visitors.

Roads of National Importance.—The state road system should include highways that are logical parts of routes for long-distance travel, whether these highways are of state importance or not; but the volume of interstate traffic is relatively small and a state is not justified in making elaborate improvements merely to accommodate interstate traffic. If each state builds a really adequate state road system, there will be little need for the national government to be burdened with the management of a national road system. The latter presents an attractive alternative to those who have an erroneous conception of the importance of interstate traffic and see advantages in centralized administration of national roads, but is fraught with many practical difficulties in the United States. It will become necessary for the federal government to act if the states fail to make reasonable provision for interstate traffic and national defense in the layout, construction, and maintenance of the state road systems.

Connection with Adjoining States.—Many state roads are in areas that preclude their becoming parts of routes for long-distance travel, but some of these carry a considerable volume of local travel across state lines. It is highly desirable that such routes connect at the state lines and the several states have been rather careful to lay out their state roads so as to connect with the trunk

lines of adjacent states even though the question of long-distance travel is not involved.

Recreation Areas.—The United States has become a nation on wheels and the recreation areas are visited by thousands of motorists each season. The season may be either summer or winter, but the great movement comes during the summer outing period. At that time the state and national parks, the forest areas, and the lake and seashore-resort districts receive an enormous influx of motor vehicles. While it is not feasible to provide state roads to serve each resort or beauty spot, trunk lines should be provided to afford ready access to these areas.

Freight Routes.—In the layout of trunk roads there has been less thought of providing for freight traffic than for automobile traffic. The automobile traffic already existed in large volume when the state systems were being established, but the freight traffic could not develop until good roads were available. The state roads, in some instances may serve to supplement rail lines, although in general the state roads parallel the railroads and permit the development of competing transportation ventures. The extent to which freight traffic will be diverted to the highways is largely a matter of speculation, but the indisputable trend is toward a very great increase in commercial highway freight traffic on the state trunk-line highways. This must not be lost to sight in the expansion of highway systems.

National Defense.—Whatever may be the plans devised by civilization to circumvent armed warfare, many years will elapse before their fruition. The nation meanwhile will be compelled to maintain certain requisites for national defense, and to have the facilities for preventing aggression. Should war develop, the actual combat might be in the air or under the sea, as well as by the older methods; but whatever the theater of action, supply and the movement of troops will require extensive use of the public highways. Each state should take this into account by improving such roads as are likely to be of military value. This applies more particularly to states bordering the seaboard, since no one can conceive of such a need along either international boundary.

SELECTION OF STATE ROADS SYSTEMS

The state road systems are now well established and were selected in various ways and by whatever authorities happened

to be designated by legislative enactment. Usually, the work was carried out either by the state highway department or by the county highway officials subject to review by the state highway department.

Preliminary System.—The first step in the selection was to prepare a tentative layout for the system, including many alternate routes. In the preparation of the preliminary layout, the suggestion of all interested citizens was given consideration although it must be obvious that personal and community interests resulted in the presentation of many conflicting suggestions. The various proposals were sifted and evaluated, the most promising being incorporated in a preliminary layout which served as a basis for an intensive study with a view to the final selection. In some states the county highway authorities selected those roads that they believed should be parts of the state road system and the routes thus indicated formed the basis of the preliminary state system; but the county boards of adjoining counties frequently failed to agree on roads that connected at the county line, which necessitated extensive revision before a suitable arrangement could be perfected.

Final System.—Having mapped out a tentative system that conformed in general to the specification for the state system, an intensive study of each road was made by the state highway department. Trained parties traveled each road, logging the topographical features such as grades, general drainage conditions, types of soil, available surfacing materials, railroad crossings, and type of development existing or possible in contiguous territory. These surveys were then tabulated and eliminations or modifications of the preliminary selection were made in accordance with the evidence thus obtained. This resulted in the formation of the tentative final system, which was mapped and given wide publicity. Public hearings were held in many counties, and after all possible information was at hand the final selection was made.

There is always provision for modifications and additions to the system thus established as the need becomes apparent.

The state highway systems usually comprise from 5 to 10 per cent of the total road mileage of the state and are estimated to carry from one-half to three-fourths of the entire volume of the traffic in the state.

UNITED STATES HIGHWAYS

In the administration of federal aid for highways, some difficulties arise because of the disposition to use the federal funds merely to augment the state funds for highway improvement. The leaders in the move for federal aid felt that there should be an attempt to confine the use of federal aid to the roads that were parts of routes for long-distance travel and that might become important in connection with the national defense. At the same time there was a desire to avoid forcing the federal government into a program of road building. It was finally decided to enlist the help of the states in setting up a system of national roads upon the improvement of which the states would concentrate. Accordingly, the Bureau of Public Roads invited each state highway department to select the roads in its respective state that should be a part of the national system. When all states had responded, the task of reconciling all conflicting proposals as to routes was referred to a special committee representing the Association of State Highway Officials and the Bureau of Public Roads. After many months of effort and numerous hearings, a system of roads was selected which is the nucleus of a national system for the United States. Modifications will be made as the need develops, but an impetus has been given that will have far-reaching influences on highway development in the United States.

IMPROVEMENT OF STATE AND NATIONAL HIGHWAY SYSTEMS

When the state systems of trunk highways were finally established, almost every type of roadway surface was represented on the roads comprising the system. The public naturally expected these state roads to constitute through routes and began to use them for long-distance travel, complaining bitterly if they encountered poor sections. The states were confronted with the necessity of improving an enormous mileage of roads in the space of a few years.

The situation was greatly complicated by the fact that in many states no provision was made for the maintenance of the roads that were taken into the state system until they were reached in the construction program. In most cases these roads had been under the jurisdiction of either the county or the township boards and these immediately greatly reduced or entirely discontinued expenditures on the state routes. The state could

reconstruct but a small portion of the system each year and in consequence there was a lack of continuity in the reconstructed roads.

Three general plans were proposed for meeting the situation.

1. To rush the construction of the state system as fast as possible by securing authorization of a state bond issue to finance the work. Meanwhile, little or no attention to be given to the unimproved section of the state routes. The theory was that the maximum benefit would accrue by hastening the surfacing of the system.

2. To maintain the existing surfaces on the trunk system in as serviceable a condition as possible, while constructing a substantial mileage of high-type surface each year.

3. The preparation of a large mileage of unimproved roads for some type of wearing surface by reducing excessive grades, straightening and widening the existing roads, and constructing the required drainage structures. These roads to be maintained as earth roads until a low-type wearing surface could be applied. The construction of high-type surfaces to be held in abeyance except where traffic was very heavy.

From these several divergent policies there gradually developed the plan of progressive road improvement. This plan is based on the hypothesis that the maximum benefit will be afforded to an area if all parts of the trunk-road system are graded, then surfaced with a low-grade surface and finally paved with a high-grade surface. The theory of this plan is that it gives highway service to the maximum number of people, although not at first producing surfaces of the maximum serviceability.

The states may be roughly grouped in three classes as regards the status of the trunk highways. In the first group are those in which the state roads have already been surfaced with some material that provides year-around serviceability. The New England States are typical of this class. These states are concerned with the change from intermediate to the highest types of surfacing, and in widening road surfaces, eliminating dangerous sections, and in other ways changing to the highest types of improvement.

A second group includes those states that have fairly well-graded roads and a considerable mileage of low and intermediate grade of surfacing. These states are concerned with the maintenance and extension of the low-grade surfaces and must be content

with the construction of a limited amount of high-type surface each year.

A third group is made up of those states that have an insignificant mileage of any type of surfaced roads and must begin by grading the existing roads and surfacing with low-grade material such as gravel. They will be unable to construct any considerable mileage of high-type surface for many years.

Each group has its definite problem and must organize its program on the basis of its particular needs.

The essential thing is for each state to formulate a policy consistent with its particular needs and then follow that policy for a period of years. Any general plan may be modified if the necessity arises, but progress can come only from following some well-considered program. Aimless drifting has characterized the road work of many states and the result has been unwise expenditures of public funds.

Route and Guide Signs.—The marking of the state road systems has been prosecuted with considerable vigor because of the very evident convenience of adequate guide and warning signs. The systems adopted for the designations of routes and the various types of signs need not be discussed herein. Suffice to say, the system should be reasonably uniform throughout the United States although some distinguishing feature may properly be added in each state. It is especially desirable that caution signs and danger signs be alike everywhere.

State roads are usually designed by a number and this is probably the most convenient system that could be devised; but for sentimental reasons certain routes are also named, either officially or by local custom. The roads in the national system are numbered throughout their length and are marked with a uniform and distinctive sign.

Minor Relocations.—In laying out the state trunk highways, efforts were made to select the best available routes consistent with the general specifications for the system. As the improvement of the roads proceeds it will develop, as indeed it has already, that many minor relocations, and sometimes very extensive ones, are desirable. These will arise principally out of the engineering considerations involved in the design of improvements for the routes. It should be recognized that the established state roads are merely general routes and that as improvement proceeds many changes are to be expected.

New Highways. As the population increases, the importance of short, direct routes between important centers will increase. In those states where the original road layout was on the rectangular system, which is typical of the prairie states, entirely new routes will need to be laid out on the shortest practicable line between terminals. In many instances this will involve the opening of new diagonal roads for long distances. In other instances shorter new roads will be needed to relieve congestion or provide for greater convenience of traffic. For these various reasons many new roads will be added to the state systems during the coming years.

The Highway System of the Future.—At some time in the not distant future, the state trunk highways, together with the national highways, will comprise a great system of arteries for automobile and commercial traffic and will carry a large share of the commerce of the nation. Many of the roads will be paved with some high-type surface wide enough to accommodate four or more lines of traffic. Side ditches will disappear along the busier roads and the roadside will be kept trim and sightly. Some of the roads will be lighted to facilitate night traffic and along the national routes will be service stations, tourist parks, and comfort stations. The financing and the administration of the development of such a system of highways will require the best efforts of engineers and statesmen for many years, to the end that each step in progress toward the ideal may be made at the proper time and in a way that will not disturb the economic equilibrium of the nation.

SECONDARY HIGHWAYS

The state and national roads will carry the great burden of highway traffic, but the economic importance of the highways not in those systems must not be overlooked. Of the utmost importance are those roads that connect the smaller towns with the trunk highway system. In states where agriculture in any form is practiced, it is imperative that farm-to-market roads be provided, which involves the improvement of feeder roads connecting agricultural areas with the trunk road system or with the market towns. These secondary roads present many problems of administration, the most difficult being the financing of the construction of low-type surfaces.

County Highways.—Several states have recognized the need for developing these main market roads by segregating them in county systems to be maintained by the respective county boards. Hence, the roads in this system are commonly called county roads. In a few states, the state highway department has general supervision of the improvement of the county road system, which is generally exercised by requiring the county boards to submit plans and specifications to the state for approval.

The roads in this class are those connecting small towns with the trunk system and roads that serve areas remote from the trunk system. The mileage in the average county road system is from 10 to 15 per cent of that of all of the roads in the county. These roads are being gradually improved by the construction of the intermediate or low-type surfaces.

Township Roads.—All of the roads not included in the national, state, or county systems remain under the jurisdiction of the township or district boards. While the mileage of these roads is large, the aggregate mileage of travel on them is very small. They merely serve to connect the farms with the county or state systems and are for the most part earth roads or are surfaced with gravel, sand-clay, or some other low-type material. They are of vital importance to those who must use them to reach the more highly improved roads of the county and state system.

CHAPTER V

HIGHWAY SYSTEMS OUTSIDE THE UNITED STATES

Unless there has been occasion for information on the subject, it is likely to be assumed that the problems encountered in evolving a highway system for the United States are without historical precedent and are unique in character. Some of them are peculiar to our environment, but the major movements of highway sentiment that have led to the types of highway systems and administrative organizations developing in the United States parallel very closely the slow march of highway progress in other lands.

Brief summaries, therefore, are presented of the growth of highway systems in lands beyond the boundaries of the United States, to illustrate how much alike are the highway problems throughout the world and that among many nations the methods of administration are strikingly similar.

Canada.—The hustling and virile Dominion to the north of the States has a peculiarly difficult highway problem because of the great area to be served and the relatively undeveloped status and sparse population of the western provinces. For a number of years Canadian statesmen have been wrestling with the situation, and with characteristic progressiveness have adapted to their conditions some of the best features of the highway systems of the States and of European nations.

It is interesting to note that up to the present time the cost of road improvements in Canada have been met by current funds, and recent proposals for the issuance of debentures for highway improvement have met with general opposition.

In the period prior to the Confederation of the Canadian provinces, which occurred in 1871, highway development in Canada was exceedingly slow, the waterways being utilized almost exclusively for intercourse between the various parts of the vast domain. The small amount of road work actually carried out in that period was wholly by local initiative or for military purposes and was usually supervised by the Royal Engineers. Labor was supplied by the settlers in lieu of a road tax.

In the period from 1871 to 1919, Canada was growing into a unified nation and was being settled and developed. In this period each province was a unit of road administration and the county and township were subunits. Toward the end of this period, the provinces aided the counties and towns with grants of funds for road improvements in amounts varying from one-fourth to one-third the cost of the work. By the end of the period each province had a more or less stable department of public works, or an organization corresponding thereto, and some classification of highways by which the responsibility of the province, the county, and the township were definitely established with reference to certain parts of the road system of the province.

In 1919 the Canadian Highways Act of the Canadian Parliament became a law and ushered in a new era in the development of the highways of the Dominion. The act provided for the classification of the highways of the Dominion and the granting of federal aid to a limited system of national roads. The sum of $20,000,000 was provided by Parliament to be allotted to the provinces on the following basis:

1. To each province, $80,000 (a total of $720,000) each year for 5 years.

2. The remainder of the $20,000,000-appropriation to be distributed to the provinces on a basis of population.

It was further provided that the allotments must be secured through the adoption of contruction projects approved by the Canadian Highways Commission, and that the federal allotment must not exceed 40 per cent of the total cost of the work.

It was originally planned that all construction provided for under the Canadian Highway Act should be completed in 5 years, but that period was later extended 2 years.

Under the provisions of the Highway Act, there was established a system of Canadian National Highways comprising some 25,000 miles well distributed throughout the Dominion and about 3,000 miles of this system was improved in a manner suitable for the traffic. The operation of the act has also served to strengthen the Provincial highway departments and to stimulate greatly general interest in road improvement. It is not yet assured that federal aid will be continued beyond the original $20,000,000, but there is in Canada at this time some sentiment in favor of a continuance of the policy.

By the year 1925, Canada had progressed to a stage where each Province had a competent and active highway department, in control of the main roads of the province, authorized to give financial aid to the counties and towns under certain restrictions and a national system of roads of which about one-third the mileage was adequately improved. A healthy sentiment for road improvement was apparent and the work of the county and township boards was responding to the example set by the Provincial organization. A typical provincial highway department organization is shown by the diagram in Fig. 5.

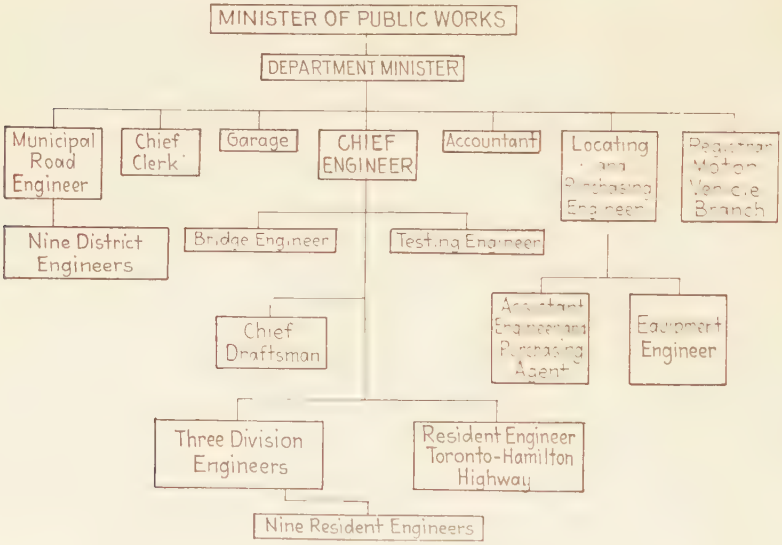

FIG. 5.

England. It is interesting to note that England furnished the pattern after which the early systems of highway administration in the New World were modeled, yet the British Isles have been rather slow to adopt some of the schemes that have, in recent years, found favor in the United States and Canada. The situation in England is most admirably presented by Sir Henry P. Maybury, Director-general of Roads, Ministry of Transport, as follows:[1]

[1] "Local and Central Authorities in the Development and Maintenance of Roads," a paper read at the Second Summer Conference of the Institute of Public Administration held at Oxford, July, 1924.

To gain a just view of highway administration as we see it today in England, it is essential to trace it back to its origin, in the hope of discovering the tendencies which have been operative in the past and which we may expect to exert a continuing influence in the future.

It would be ungracious to omit reference to the Romans, whose engineers laid down so large and admirable a portion of the road system which we use today; but although their highways have endured, it cannot be said that their principles of highway administration left any permanent trace. Upon the withdrawal of the Roman legions, the conception of a state responsibility for highways may be said to have lapsed for nearly 1,500 years; and if we cast our eyes back to the Highways Act of 1555, we shall find no organization extant save the most primitive and rudimentary, namely, the immemorial parish, which Blackstone describes as "that circuit of ground in which the souls under the care of one parson or vicar do inhabit"—the Church having stepped in to fulfil functions neglected by the state. If highways were thus confirmed in their status as a mere parochial liability, it is interesting to observe the first inkling of a sense of regional responsibility in the somewhat kindred cases of bridges—as shown by King Henry VIII's Statute of Bridges, 1530–1531, which casts upon the county the liability for maintenance of bridges and their approaches. It will be recalled, however, that the actual construction of bridges was usually due to private benefactions or charitable trusts.

So long as road traffic was of short range, and water-carriage remained the means of transport for heavy goods, the parish managed to carry its burden without excessive strain, although very inefficiently; but after the middle of the seventeenth century, the creation of the Post Office in 1660, and the passing of the first Turnpike Act of 1663, provide evidence that the parochial organization is being strained almost to breaking point.

In 1773, at the dawn of the mail-coach era, however, the General Highway Act still finds the parish holding the field with the aid of the turnpike trusts; and the last of the General Highway acts, that of 1835, continues to retain the parish as the administrative unit (subject to a provision permitting the grouping of parishes); the surveyor of highways is still to be elected annually by the parishioners.

Signs of an impending breakdown are occasionally discernible, and led in one case to an interesting modification of the system. I refer to the creation of a comprehensive regional authority in South Wales, under the South Wales Turnpike Trusts Act, 1844, which followed the socalled "Rebecca" riots of the previous year. All turnpike trusts in the counties of Glamorgan, Brecknock, Radnor, Carmarthen, Pembroke, and Cardigan were consolidated; county road boards elected; county road funds established; the tolls pooled; and even county road rates levied at need. One may, perhaps, be permitted to regret that this

very promising experiment in regional or provincial highway administration was not more vigorously pursued and that under subsequent legislation these six counties were assimilated to the rest of the country.

A general forward movement is marked by the passing of the Public Health Act, 1848, under which local boards of health were set up in urban districts and were granted the powers previously exercised by the Surveyor of Highways for the parish. The number of these local boards was increased by the Act of 1858, and in 1862 another Highway Act was passed providing for the grouping of country parishes into highway districts administered by a Highway Board.

By the Public Health Act, 1872 (consolidated by the Act of 1875), England was parcelled into urban and rural sanitary districts, highway powers being conferred upon the urban authority; while in rural districts, highway administration, as then existing, remained unaltered.

Through all these minor changes we still see the district left to struggle unaided with the highway problem . . .

. . . That broader views must prevail, and that the contributory area must be extended, is the keynote of the Highways and Locomotives (Amendment) Act, 1878, the title of which reminds us of the emergence of a rival to the horse.

This act provides for the enlargement of highway districts to conform to the boundaries of the rural sanitary districts. It marks the end of the turnpike road and brings into being the "main road," towards the maintenance of which one-half of the expense was to be borne by the county—probably the most noteworthy landmark in the history of English highway administration since the withdrawal of the Roman garrison, more than 1,400 years earlier.

In 1882 followed the recognition of a state responsibility for highways, a grant of 250,000 pounds being voted by Parliament in aid of the cost of maintaining main roads—another noteworthy event. The grant represented one-half of the amount of the county contribution, so that, in effect, half the cost of main roads was paid by the county, one-quarter by the government, and one-quarter by the highway authorities.

In 1887 the Parlimentary vote was doubled, so that one-half of the cost was borne by the state, a quarter by the county, and a quarter by the Highway Authority.

A further step in what I may call the broadening process is marked by the Local Government Act of 1888, which transferred the control of, and liability for, main roads and bridges to the county council—now first brought into existence. Financial assistance from the state to the county councils was afforded by an Exchequer contribution.

The scheme of local highway administration as we see it today is completed in general outline by the Local Government Act of 1894, which sets up the rural district council as the highway authority within its own area.

Even the spacious framework of the county was felt to be too narrow for the ever-widening circle of traffic development, and the passing in 1909 of the Development and Road Improvement Funds Act testifies to the growing sense of national responsibility for road communications.

The Road Board constituted by that Act was empowered to construct and maintain new roads, and to make advances to highway authorities for the construction of new, or the improvement of old, roads.

The setting up of the Road Board, and the recognition thus afforded of a more definite State obligation in highway matters, is of sufficient historical importance to warrant the quotation of an extract from the First Annual Report of the Road Fund dated August 18, 1911.

The Road Improvement Grant which the Board have to administer arises from the motor-spirit duties and motor-car license duties imposed by the Finance Act, 1910. The Road Improvement Fund is credited with the whole of the proceeds, less the cost of collection, of all excise duties now payable in respect of carriage licenses after payment to local authorities through the Local Taxation Accounts of the sums mentioned in Part V of the Revenue Act, 1911.

On the basis of the Treasury estimates, it appeared probable that the total amount which could be treated by the Road Board as available for advances which might become payable within the calendar year 1911 would exceed 1,200,000 pounds, but there was some uncertainty as to whether the motor-car license duties payable within the calendar year 1910 would realize the full estimate. The Board therefore decided to adopt 1,000,000 pounds as the basis for their first distribution of grants. The amounts actually credited to the Road Improvement Fund up to July 8, 1911, in respect of the financial years 1909–1910 and 1910–1911 have aggregated 1,161,344 £ 18s. 10d.

As an exceptional but significant incident in the relations of central and local administration, mention should be made of the 10,000,000 pounds road and bridge programme of 1919–1920, towards which the government made a contribution of 8,000,000 pounds as an addition to the sum of 2,000,000 pounds provided from the Road Improvement Fund. The programme formed one of the emergency measures necessitated by the demobilization then in progress, and the fund of 10,000,000 pounds was distributed in grants to local authorities for the strengthening, reconstruction, and re-surfacing of roads and bridges.

The Road Board has now been merged in the Ministry of Transport under the Ministry of Transport Act, 1919, which again enlarges the province of the central authority and provides for the classification of roads as a basis for the allotment of government grants to highway authorities. That classification has now become effective, the mileage at the date of the last annual report being as follows:

England and Wales	Class I	18,262 miles
	Class II	11,478 miles
Scotland	Class I	4,968 miles
	Class II	3,259 miles

(The mileage of roads of all classes in England, Scotland, and Wales is estimated to 177,321 miles.)

Towards the cost of maintaining and improving Class I roads, the normal grant from the Road Fund has been at the rate of 50 per cent; and in the case of Class II roads, 25 per cent. Grants are made under various heads, *e. g.*, contributions towards the salaries of highway authorities, surveyors, special assistance towards the improvement of rural roads, the construction of new arterial roads, bridges, etc.

The receipts of the Road Fund have steadily increased; in 1921, the figure stood at 9,432,302 pounds; in 1922, 12,585,633 pounds; in 1923, 12,802,754 pounds: this last named figure may be taken to represent somewhere between one-quarter and one-third of the total expenditure incurred by all highway authorities in England, Scotland, and Wales.

The relationship of central and local administration has not been materially modified by the Roads Act of 1920, which deals mainly with questions affecting the licensing of vehicles. Perhaps the most interesting provision is that enabling county councils to appeal to the Ministry of Transport for the prohibition or restriction of certain forms of traffic on highways unsuitable for such purposes.

The setting up of this Court of Appeal appears to have been generally welcomed.

In the foregoing summary I have endeavoured to sketch the gradual rise of the composite system of highway administration which prevails today, and which, like other stratified formations of slow growth, contains here and there a few fossil remains of greater interest than utility. Despite these shortcomings, however, on which a theorist might dilate, it is consoling to find that, as the outcome, no other country provides the traveller with a more serviceable or better distributed network of roads.

The administrative system which we inherit today is the result of a development which reflects the peculiar genius of our race for local government, though it must be allowed that private enterprise played a vigorous and valuable part during the turnpike era; since 1878 the transformation has proceeded rapidly, by comparison with previous centuries, and no thoughtful observer of British institutions will claim that finality has yet been reached. The tendency for the past fifty years has been for highway administration to "broaden slowly down from precedent to precedent."

Almost every change has been directed (as in the similar case of railways) to the spreading of burdens over a wider and wider field, to the pooling of resources, to the grouping of communities for the efficient dis-

charge of a common duty, to the invocation of the state as a vitally interested party in the communications of the country. A fruitful and serviceable partnership has been set up between district councils, county councils, and the state, each of the parties accepting a degree of responsibility corresponding in some measure with the functions of these different grades or strata of administration. Broadly speaking, roads of local utility are maintained by the district councils, with only occasional help in special cases from county or state; while the upkeep and improvement of main roads is entrusted to county councils, who, in so far as the roads are classified, receive from the Government Road Fund, grants of 50 per cent for first-class roads and 25 per cent for second-class, a few exceptional cases receiving special treatment.

There is no reason to suppose that the terms of the partnership are immutably fixed for all time. At many points there appears room for adjustment, if not equalization. The London Traffic Bill is perhaps symptomatic. As traffic conditions alter, one may expect to see the length of the classified roads increased; this process of revision is continuous.

It is conceivable that additional categories of classified roads might be created, either at the top or bottom of the scale.

One would like to see a closer conformity between the two conflicting standards—the roads classified by the state on the one hand, and the roads declared "main" by the counties on the other hand. A road that is sufficiently important to gain regular subsidies from the State Road Fund is *a fortiori* worthy of acceptance as a main road by the county. In many areas this principle has secured recognition with unquestionably good results in the equalization of the highway rate; and many students of local finance believe that there is no more promising remedy for the grievances expressed by some rural district councils, whose resources and equipment are obviously inadequate for the task of highway maintenance now imposed upon them. When one sees what painfully diminutive salaries some of the smaller authorities offer to their Highway Surveyor, it is impossible to avoid the conclusion that some grouping policy should be encouraged which would enable adequately paid posts to be created for properly qualified officers.

It is worthy of mention, in passing, that in Scotland rural road administration rests on a wider basis than in England. North of the Tweed the Rural District Council has no existence, and its place as a highway maintaining authority is filled by the District Committee of the County Council.

There is probably no greater anomaly in local government today than the widely divergent practice of county councils (England and Wales) in the matter of "maining" roads.

The very term "main road" possesses a totally different significance in adjoining counties. Under the liberal policy of one county, every road

of any general importance is "mained," whether it is comprised in the government's classification scheme or not; in other counties only a portion of the classified roads are accepted as main. This extraordinary divergence can be illustrated by setting side by side the counties of Huntingdon and East Riding. In the former case, the whole of the roads are main; in the latter case, only 8.56 per cent. How the want of uniformity originated is familiar to us all. Under the Act of 1878, the roads which automatically became "main" roads were those which had been "disturnpiked" after an arbitrary date (December 31, 1870). Consequently, those counties in which there had been few turnpike roads, or in which the disturnpiking had taken place at an earlier date, started their career with the shortest list of main roads. Subsequent additions to the length and number of main roads have been entirely at the discretion of the county councils, whose policy has varied so widely in this matter that, as already mentioned, the term "main" road cannot be said to depict a system of highway conforming to any logical formula.

The way, however, lies open to the local authorities of the county to put matters on a more consistent footing by friendly negotiations among themselves, and no small measure of progress has already been achieved.

Another task that looms ahead is the modernization of the highway system and bridges of the country to meet the growing demands of a constantly increasing traffic. This formidable work, which is clearly differentiated from the usual routine of repairs and resurfacing, will severely tax the organization of many local authorities, especially the less wealthy rural district councils. Much can be done by combined effort, and I believe that populous thriving centers of commerce, whose streams of traffic pulse to and fro across the adjoining rural areas, will be prepared to assist their poorer neighbors in the task of transforming the highways to carry this traffic.

During the past five years, many such schemes have been successfully carried through with the aid of the Ministry of Transport, and I want no better omen for the future.

The same spirit of goodwill and mutual accommodation, which has carried the country through the revolution caused by the advent of motor traffic thirty years ago, will enable the local and central authorities to grapple fearlessly with the fresh adventures that lie before them.

France. The State Department of Roads and Bridges, of France, was organized under an Order of Council dated Feb. 16, 1716, and by the middle of the eighteenth century there was in France a very extensive network of roads which had been built and maintained almost wholly from funds provided from the Royal Exchequer. The first Republic made provision for the maintenance of these roads from funds supplied by the national Treasury.

In 1797 these roads were divided into three classes as follows:

I. Roads leading from Paris to the frontiers.

II. Roads leading from frontier to frontier, but not passing through Paris.

III. Roads connecting towns.

Thus, as early as the end of the eighteenth century, France had a well-defined and classified system of roads and a system of technical control.

Napoleon I, in 1811, placed the cost of maintenance of Class III roads on the departments, but the State Department of Roads and Bridges retained technical control.

Little change in the general plan of administration has taken place since 1811 so far as the national roads are concerned, but the development of other classes of roads has gradually been brought into harmony with that of the national roads.

At present the highways of France are comprised in four groups as follows:

I. National highways (*routes nationales*).

II. State highways (*routes departmentales*).

III. Main roads—county roads (*chemins des grandes communicationes, and chemins d'interct commun*).

IV. Local roads—township roads (*chemins vicinaux ordinaires*).

Roads of Class I are improved and maintained wholly at the expense of the national government and under the supervision of the National Department of Roads and Bridges.

Roads of Class II are improved and maintained at the expense of the Department and the work is in charge of a departmental road service appointed by the Department Commission.

Class III roads connect with the smaller cities and villages and are improved and maintained from funds of the communes, supplemented by grants from the Department. They correspond somewhat to the state-aid roads of the United States.

Roads of Class IV are the responsibility of the commune, and the mayors of the towns are in charge of the care of the roads. The cost of maintenance is borne by the commune.

Thus, it will be seen that France has for many years possessed a classified system of highways with authority and responsibility assigned to the various political subdivisions of the government. She has long followed the policy of national financing and supervision of the main arterial highways. A policy closely akin to

state aid has also been in operation for a long time. In fact, it is generally recognized that France has long enjoyed the benefits of a system of road management to which other nations must eventually turn.

The most significant factor in the French organization is the long-established National Department of Roads and Bridges (*Service des Ponts et Chaussées*) which has established a technical staff of commanding professional attainments. The system has been such that the principal members of the organization have had long-continued service in the *Service*, and the spirit of the whole staff is progressive and its work is based on the most painstaking consideration of all of the theoretical and practical factors involved in the French highway problem. The staff of the department is made up of some of the outstanding highway experts of the world.

Norway.[1]—Norway is a long, narrow strip of coast country of exceedingly rugged configuration, and with a harsh climate over most of the area. Along the west coast, however, the climate is relatively mild, due to the proximity of the Gulf Stream.

Road progress in Norway began in the year 1274 with the enactment of a law that set up a plan for road improvement and means for making it effective. In 1824 an act was passed that provided for the division of the highways of the nation into two classes.

I. Main highways to be paid for by the state.

II. County highways to be paid for by the county, except that in special cases advances might be made by the state.

The highways of each county were placed under the care of the sheriff. Maintenance was charged to the districts in which the work was done.

In 1851 a new act was passed that placed the financing of the main roads in the hands of the Congress and of the county highways in the hands of the district court. The administration was unchanged otherwise. In 1893 an act was passed permitting joint administration of road improvement by county and state. In 1912 the law was passed under which Norway is now operating.

Previous legislation (1893) had permitted a county (corresponding politically to a state in the United States) to appoint a road engineer who not only supervised the county road work,

[1] *Highways of Norway*, a monograph by A. A. Baalsrud, Director of Highways, Oslo.

but also the state road work in the county, and several counties had organized on that basis. The law of 1912 established this system for the whole country and is still in effect.

Norway now has a state director of public roads with a staff of ten engineers in the head office at Oslo. In each county there is a chief engineer (eighteen in all) two or more division engineers, and one or two assistant engineers. The director of public roads has full supervision of the main roads which are constructed and entirely or chiefly maintained by the state. He also approves plans for new highways and bridges in the counties and authorizes the construction thereof.

The roads within the county are under the control of a county highway board, which consists of a chairman appointed by the state and two men appointed by the county council. The county engineer is in direct charge of all technical work while the county board assumes the supervision of maintenance.

For the purposes of financing, the roads are classified as follows:

I. Main highways, which are (*a*) trunk highways connecting Norway with other countries or connecting one county with another; (*b*) highways within a county carrying through traffic between two or more districts or connecting a district with a town.

The state bears the cost of new, or the improvement of old, main highways, but the Congress may require the districts to refund a part of the cost if local benefit is shown. On the average the districts refund about one-fourth the cost, but in many cases they are not asked to refund any part of the cost.

II. County highways, which comprise all roads aside from the main roads. County highways are improved according to the decision of the council of the district (corresponding to a county in the United States). County aid is granted in some cases and usually amounts to about one-fifth of the cost of the work. It is authorized by the county court. National aid is also granted in some cases, and amounts to about one-half the cost of the work. It is authorized by Congress.

It is therefore apparent that Norway has a classified system of highways with the responsibility for each part of the system clearly fixed. It has a scheme for technical supervision of the engineering work on the highways throughout the nation with an authoritative and stable National Department of Public Roads to unify the work throughout the nation and to promulgate standards of construction and maintenance. It is also to be noted that

state and county aid are provided for, and the practice of employing national funds for main roads is well established.

Denmark.—This thriving little country is scarcely larger than the state of Delaware, and consists of the mainland and innumerable islands. Naturally, water transportation is utilized to a very great extent, but the fact that in 1924 there were about 45,000 automobiles indicates that a highway problem exists.

Highway construction had its inception in Denmark in 1764, when the Crown borrowed a French road engineer to lay out and begin the construction of a system of national or Royal roads at the expense of the national government. The projected system was not completed until over a hundred years later, in 1867, and consisted principally of broken-stone macadam. When railroad building began in Denmark, the national government assumed that the Royal roads, which had up to that time been maintained at government expense, would henceforth be used for local traffic only, and relinquished control to the departments or counties, and thus established a decentralized system of highway administration.

The roads of Denmark, outside of the towns are of three classes:

I. Highroads, which are roads so classed by the Ministry of Public Works. The highroads of each county are administered by a county road inspector and his staff. The county road inspector is appointed by the county council. A chief road inspector is appointed by the Ministry of Public Works, whose duty it is to see that the county councils maintain the highroads in a manner suitable to the needs of traffic. This general inspection is the only supervision exercised by the national government. The counties pay all costs of road work on highroads in the county.

II. Byroads, which are roads so classified by the county councils. These roads are administered by the parish boards, under general supervision of the county road inspector or a byroad inspector appointed for that purpose by the county councils. The cost of work on the byroads is paid by the parish in which the road lies, except that sometimes the county councils grant funds to the parish for a part of the expense. Occasionally, repairs are executed by the parishioners, the byroads being divided into parcels and a parcel assigned to each lot owner to maintain.

Footpaths are ways that are classified as public footpaths by the parishes.

In every county the sheriff, who is chairman of the county council, has supervision of all roads of all classes and if necessary can make a report of the condition of the roads to the National Ministry of Public Works who may take action to bring neglected roads up to a suitable state of repair. The Ministry also settles all claims and differences of opinion that may arise among the county councils or the parish boards with reference to road matters, but the county councils and the parish are free to select road types and methods of construction.

The national government contributes to the cost of road construction and maintenance only in that the motor-car tax is collected by the government and distributed to the counties and towns according to rules fixed by law.

It will thus be seen that in Denmark, the roads are administered by the local units of government subject only to general supervision by the national government, and that the motor-car tax is used for highway purposes. A classified system of roads has been worked out with authority over each class definitely fixed.

Switzerland.—The republic of Switzerland has long been held in admiration because of its intense individuality and perhaps through the romance engendered by innumerable references to Alpine scenery and Swiss villages that appear throughout a great deal of our most enchanting literature. Yet to reach the beauty of this rugged land and to permit the ordinary avocations of a nation, roads are necessary, and in this instance the roads are built and maintained amidst the most difficult topographical conditions and with exceedingly meager financial resources.

In Switzerland, road construction and maintenance are preeminently the affair of the canton and its subdivision, and the council of state of the canton serves as a referee board for the adjudication of disputes that arise and assumes general supervision of the highway system.

The highway system of the canton of Vaud, therefore, will be described, since it is fairly typical of that of the other cantons.

The roads and public ways of the canton are under the supervision of the Department of Public Works of the canton and the Commissioner of Public Works prescribes general regulations for the construction and maintenance of roads in conformity with the law. The laws of the canton of Vaud are exceedingly detailed with reference to the construction and use of highways, covering

the subject much more minutely than do the laws in the states of the United States or the provinces of Canada. In each parish there is a commissioner of roads whose duties are prescribed by the law of the canton, but who is an officer of the parish.

The roads and ways of the canton of Vaud are of three official classes, each road being assigned to a class by decree of the Grand Council of the Canton.

I. Through routes of the canton, or main roads.
II. The local roads of the canton.
III. Community or parish roads.

In addition there are lanes, private roads, and village streets that are not included in any classification.

The cost of improvements of any section of a road is in general borne by the parish, but, in the case of Class I roads, the cost is borne jointly by the canton and the communes interested according to a very elaborate system of allocating the portion of the cost to be paid by each unit participating. In some instances part of the cost is assessed against the adjacent property. A system of "state aid" is employed for roads of Class I and Class II.

The foregoing brief outline shows that in Switzerland the state system of road management is in effect with the canton (which is organized much like an American state) as the major unit. The subordinate units are the commune and the parish. The roads are grouped into classes according to importance and the care of each class of roads assigned definitely to some official body. In paying for road work the principles of state aid, county aid, and special assessments are recognized and practiced. The methods of improving and maintaining the roads and the regulations of traffic are prescribed by law in great detail.

Czechoslovakia.[1]—The Czechoslovak republic was born of the travail of the World War. It was formed by the Union of five countries, Bohemia, Moravia, Silesia, Slovakia, and Carpathorussia. One of the problems confronting the new republic was the establishment of a unified system of highway administration. This has in part been accomplished and in part contemplated in a new highway law which is being formulated by the Ministry of Public Works of the republic.

The administration of control of the main roads (state highroads) of the republic rests with the central government and is in

[1] Data secured through courtesy of Antonin Hlousek, Commissioner of Highways, Prague.

reality national control of the trunk roads as is practiced in France. In the main, the state highroads are well constructed and maintained and are suitable for high-speed motor traffic and for the transport of heavy loads.

Funds for the construction and maintenance of state roads are provided for in the national budget and the administration rests with the national Ministry of Public Works, but the actual construction and maintenance work is in the hands of the county boards in Bohemia, Moravia, and Silesia. These boards in turn have divided the roads into sections to each of which is assigned the personnel required to perform the work. In the three counties there are thirty-nine sections.

In Slovakia, the highroads are under the jurisdiction of divisional representatives of the Ministry of Public Works. There are six divisions and seventeen subdivisions or districts.

In Carpathorussia, the work on the highroads is controlled by a special commissioner of the Ministry of Public Works under whom are eight district boards in direct charge of the construction or maintenance work.

The technical work on the highroad system is in charge of the state engineers. Actual supervision of the state roads is by road surveyors who are under the state engineers. Each surveyor is entrusted with about 30 miles of road, and he will have some ten roadmen or patrolmen who perform the necessary repair work and who hire labor for the more extensive repair work.

Next in importance to the state highroads are the district roads (corresponding to county roads), which classification exists throughout the republic. These roads are improved from funds obtained by direct taxes, some contributions from the central government, and contributions from municipalities through which the roads pass. The supervision is by local authorities, but the technical supervision is by the state engineers.

The roads built and maintained by the towns and villages or communal roads are wholly under local control and the funds are provided by municipal taxes and by labor taxes.

Czechoslovakia has in formulation a new national road law modeled somewhat after the French system of administration and providing for the following classes of roads.

1. State highroads, to be built and maintained by the central government.

II. Departmental roads, to be built and maintained by the *Zupa*, or departmental government.

III. District roads, under the district administrative bodies.

IV. Parish roads, maintained by the municipalities, parishes, or communities.

V. Private open roads.

It is of interest to note that this new republic with all of the pressing problems of finance and organization with which it is beset is preparing a most comprehensive and up-to-date system of roads and an administrative system of a type recognized as most effective among all of those in existence at the present time.

China.—China is thought of as a nation with its roots extending back to the beginnings of time, and content with what the Western World conceives to be a total indifference to the march of progress and to the development of internal improvements for the upbuilding of national solidarity and commercial development. In highway development China is woefully backward and the establishment of a stable national government would seem to be a condition precedent to the undertaking of a program of highway development; but a start has been made as shown by the following abstract of the regulations relative to highway development and administration enacted in October, 1920.

THE REGULATION OF HIGHWAY IMPROVEMENT IN CHINA[1]

Art. 1. The highways of the nation shall be divided into the following classes:

a. National highways.

b. Provincial highways.

c. District highways.

d. Village highways.

Art. 2. The national highways shall be:

a. Highways leading from national capital to all provinces and special regions of the nation.

b. Highways running between provincial capitals.

c. Principal highways connecting the forts, harbors, and other highways of military importance in the nation.

Art. 3. The provincial highways shall be:

a. Highways leading from the provincial capital to all districts of the province.

b. Highways running between district cities.

c. Highways connecting railroads, mines, ports, industries, and other highways of military importance within the province.

[1] Translated by S. H. Pan of Canton, China, while a graduate student at Ames.

Art. 4. The district highways shall be:

a. Highways leading from a district city to all important cities and towns of the district.

b. Highways connecting the cities and towns of the district.

c. Highways leading from a district city to harbors, ferries, railroads, and neighboring industrial sections and mining sections.

Art. 5. The village highways shall be:

a. Highways running between villages.

b. Highways leading from village to neighboring school districts, industrial sections, and other public works.

Art. 6. The widths of the national highways shall not be less than 50 Chinese feet (1 Chinese foot is about 1¼ English feet).

Art. 7. The widths of the provincial highways shall not be less than 24 Chinese feet.

Art. 8. The widths of the district highways shall not be less than 24 Chinese feet.

Art. 9. When the topographical conditions or special reasons necessitate the reduction of the width of the national highway, provincial highway, or district highway, the width shall be determined by the Interior.

Art. 10. The widths of the village highways shall be determined by the local bodies.

Art. 11. The national highway system shall be determined by the Interior and the provincial highway systems shall be determined by the higher authorities of their provinces and shall be approved by the Interior. The Interior shall then schedule the divisions and sections of the improvement and shall notify the higher authority of that province to supervise the work; but the Interior may establish special offices directly in charge of the national highway improvement.

Art. 12. The district highway system and village highway system shall be determined by their district magistrates. The district magistrate shall then cooperate with local organizations to carry out the improvement.

Art. 13. In case highways cross rivers or canals where bridges are necessary, the widths of the bridges should be determined upon the widths of the highways.

Art. 14. The detail operation of this regulation will be determined by the Interior later.

Art. 15. This regulation will be effected from the date it is announced (Nov. 14, 1919).

THE ORGANIZATION OF THE NATIONAL HIGHWAY COMMISSION OF CHINA

Art. 1. The Commission is to prepare the necessary plan for the national highway system.

Art. 2. The Commission consists of one chairman, who is the head of the Civil Engineering Department of the Interior, and a number of commissioners appointed among the officials of the same department and other technical men from various offices.

Art. 3. The Commission shall have three divisions, general division, engineering division, and investigation division, each headed by a director who is appointed from among the commissioners by the chairman.

Art. 4. When an important bill is passed by the Commission, the chairman may ask the Minister to attend the discussion of the Interior to express the opinion of the Commission.

Art. 5. Since the Commission has to deal with engineering problems, therefore an engineer in charge will be employed.

Art. 6. The chairman shall preside at the meetings of the Commission and one of the directors shall take his chair if he is absent; but the Minister shall be the presiding officer if he is present.

Art. 7. The problems which the Commission will take up may be assigned by the chairman to certain commissioners to investigate thoroughly beforehand and to prepare maps or diagrams to illustrate the subject, and shall then be discussed by the whole Commission.

Art. 8. The bills passed by the Commission shall be turned to the Minister and from there shall be put into effect after adopted.

Art. 9. The Commission shall employ a certain number of officers to assist in the routine work of the Commission.

Art. 10. The Commission shall employ draftsmen and clerks to handle drafting and copying works.

Art. 11. This regulation will be effective from the date announced (October, 1920).

SUMMARY

These selected examples of highway systems of other lands illustrate the tenacity with which the local authorities cling to their authority in road matters and undoubtedly show that the local unit of government has a place in a system of highway administration. With the ever-changing modes of transportation, however, modifications of old systems have become imperative and these new developments present a striking similarity wherever noted.

These extracts also show how the need for technical supervision of certain classes of road work has forced itself upon public consciousness among all nations.

The outstanding impression resulting from a perusal of these outlines of highway administration in many lands might be summarized as follows:

1. The principle of classification of highways according to importance seems to be recognized generally as an administrative and constructive necessity.

2. Some form of national supervisory body aids in the correlation of the highway work of the various subordinate governmental units and is deemed of sufficient importance that nearly every nation has adopted the principle.

3. The construction of high-type highways involves materials and methods of such a character that technical supervision is deemed a prerequisite to adequate highway development.

4. The inequity of causing the smaller units of government to bear all of the cost of main-road improvements seems to be recognized all over the world. The principles of what is known in the United States as state and county aid have been adopted almost universally.

CHAPTER VI

PRINCIPLES OF HIGHWAY FINANCE

The Nature of Public Finance.—There are two kinds of finance, public and private. By public finance is meant the income, expenditure, and methods of financial administration of the state. The state, like an individual, must have sources of income to meet its expenditures and is obliged to develop methods of financial administration.

The money income of states in ancient times and during the Middle Ages was very small, judged from modern standards. For the most part, services were paid in kind and not in money. Slave labor was the principal source of income of ancient states. Serfdom was a method of paying services in kind during the Middle Ages when feudalism was the prevailing form of political organization. Military service, which now involves such vast expenditures of money, was also very largely rendered in kind. It was the duty of certain classes to fight wars just as other classes were required to perform the hard labor. No comparison of the income and expenditure of ancient, medieval, and modern states can be made without considering these facts. The real burden of supporting the State, measured in terms of the individual contribution of time by the majority of the population was no doubt much greater in ancient than in modern times.

Government in a country like the United States must adjust itself to the principle of dual sovereignty. The federal government under the Constitution of the United States is a government of delegated powers. All powers not delegated to the federal government in the Constitution, nor prohibited to the states by it, are reserved to the respective states, that is, to the people. This means that sovereign authority is partly vested in the nation and partly in the forty-eight states. The states, in turn, delegate administrative powers to counties, cities, townships, school districts, park boards, and other forms of local political organization.

Public finance in the United States includes the revenues, expenditures, and methods of financial administration of the

federal government, the government of forty-eight states possessing a measure of sovereign authority, and of the various local systems of government legalized by the several states.

There is, then, a national, a state, and a local public finance.

Classifications of Public Revenue.—Public revenue may be obtained from the following sources: the public domain, public industries, fees, special assessments, miscellaneous sources, such as fines, forfeitures, expropriation, escheats, gifts, and, finally, taxes. Taxes, which represent by far the most important form of public revenue at the present time, may be levied on property, income, business, the transfer of property at death, or in anticipation of death, and on persons. All forms of taxation logically fall in some one of these five groups, just as all forms of public revenue are included under one or more of the six classes. Certain facts with reference to the different forms of public revenue and the different classes of taxes have a direct bearing on the subject of highway finance and administration.

Revenue from the Public Domain.—At one time revenue from the pubic domain constituted a very important part of the income of certain European states, but that is no longer the case. In the United States, under the Homestead Act, many millions of acres of the public domain were actually given away to settlers. The disposal of the agricultural part of the public domain has not been a directly profitable business, but a large income is now received from the taxes levied on this same land to help carry on the different functions of government. It is quite possible that Congress might develop a more businesslike policy for the administration of the vast public domain which still exists, mostly as forest and mineral lands, and thus obtain a more substantial revenue to help build roads in the national forests, and perhaps assist in constructive work along other lines. The 10 per cent fund obtained from the sale of timber from national forests constituted the first source of revenue for the construction of roads in the national forests and parks.

Revenue from Public Industries.—Revenue from public industries has but little bearing on the subject of highway finance in the United States since there is less government ownership of business in the United States than in any other of the great nations, and much less than in some foreign countries. A public industry may be operated below cost, at the cost of rendering the service, or at a profit. If operated below cost, the balance

of the required income must be made up from other sources of public revenue, usually taxes. If operated at cost of production, assuming that the plant is being maintained properly and provision is made for replacement, no burden on the taxpayers is involved. When operated for a profit, the profit realized may be compared to taxes received in the event of private ownership and operation.

It follows logically that a public industry should contribute in special assessments and earnings the equivalent of what would be paid in special assessments and taxes if the industry in question were privately owned and operated. Revenue obtained from this source may be of real significance in the case of trunk-line highways or any main-traveled through roads that are located within the limits of incorporated towns and cities. Public highways being essential to the educational, social, and economic welfare of the nation, there is no reason why publicly owned industries should not contribute their reasonable and fair share of the burden of highway costs. The total revenue now being raised for the construction and maintenance of the public highways is so large that this particular sort of public revenue is relatively unimportant.

Revenue from Fees.—A fee is a direct payment for a special service rendered by the state, such as that charged for recording deeds and other legal documents. Fees are charged for a large number of purposes of national, state, and local government. In the county some offices are supported by fees or even yield a revenue over and above the cost of operation. Fees are paid by students in institutions of learning to supplement revenue obtained from taxation or endowments.

Strictly speaking, a fee must not exceed in amount the cost of a special service rendered by the government. If the so-called fee brings in more revenue than is necessary for this purpose, the additional revenue is not a fee but a special form of taxation. In a number of states, motor vehicle taxes are called fees, but a very small part of this so-called fee should be classed as such. Three to five per cent of the fee charged owners of motor vehicles in a state like Iowa is required to pay for the special service rendered by the government. All the other revenue obtained is in reality a form of taxation, the funds being used for the general purpose of improving the public highways. These general facts should be understood because of the great importance of motor

vehicle taxation, including gasoline taxes, in constructing and maintaining public roads.

Revenue from Special Assessments.—The fourth form of public revenue is special assessments. This form of revenue differs so much from taxes, both from a legal and an economic standpoint, and is so important a factor in financing certain permanent public improvements, that it is desirable to devote a separate chapter to the subject. Suffice it to say at this time that little has been written in a systematic and thoroughly scientific way regarding this important class of public revenue. It is quite apparent that the true significance of special assessments has not been generally appreciated by writers on public finance.

Revenue from Miscellaneous Sources.—Miscellaneous sources of public revenue should be mentioned because in this class is included expropriation under the power of eminent domain. When a new street is to be opened or an old street widened, private property must be taken for public use. In the event that only enough property is thus taken to make possible a given improvement, which has been the rule in the United States, there is no revenue; but on the contrary a definite expenditure, which must be met out of taxes, special assessments, or some other form of public revenue.

If more property is taken over than is necessary for a given public improvement, the rise in the value of this additional property resulting from the improvement may become a source of revenue. This practice, which is technically called excess condemnation, is not uncommon in Europe and results in giving the general public the benefit of what is known as unearned increment. This policy is being seriously discussed in connection with proposed highway improvements in the United States, and is mentioned as a possible source of revenue if it is legal and constitutional and is regarded as expedient and desirable.

TAXES

The most important form of public revenue in modern times is that derived from taxation. Taxes may be levied on property, income, business, the transfer of property at death or in anticipation of death, and persons. Each form of taxation will be discussed briefly in its relation to highway finance.

Property Taxes.—The most important single source of public revenue for construction and maintenance is taxation of property.

There are several different kinds or classes of property taxes. There may be a general property tax, which means a uniform levy in any political unit, on all classes of taxable property, both real and personal, tangible or intangible. There is a classified property tax, such as that in Minnesota, where each of the several classes of property is assessed for taxation on a different basis, such as 25 per cent, 40 per cent, or 50 per cent of the actual value. The property tax may be limited in other respects. Some classes of property, such as farm mortages, may be subject to a flat rate or possibly a mortgage registration tax. Moneys and credits in several states are subject to a flat rate of 3, 4, or 5 mills, generally uniform throughout the entire state. A state income tax may be imposed and be in lieu of property taxes on certain classes of property, usually intangible personality. While property tax systems differ very materially in different states, the property tax remains the backbone of the state and local revenue system of a large majority of the states. For years to come, this tax in its various forms will continue to be of outstanding importance in connection with the construction and maintenance of the public highways.

The various road and bridge levies made in the county, township, and other subdivisions of local government throughout the country cannot be understood or compared except in the light of some definite knowledge of the method of assessing property for purposes of taxation. A 1-mill tax levy in many states would mean as great and possibly a greater tax burden than a 4-mill levy in Iowa. This is due to the fact that taxable value in Iowa is arbitrarily fixed at one-fourth of the listed value, which in turn may be not more than 40 or 50 per cent of the actual value of property. In a state not practicing fractional assessment, but listing property very close to its actual value, a 1-mill tax levy might represent a higher tax than does 4 mills in Iowa.

In the rural districts throughout the entire United States, the general custom is to leave the assessment in the hands of locally elected township, city, or county officials. In the larger cities of the country, this work is done by appointed officials that may be much more efficient. In states where the county form of local government predominates, the county is the unit of assessment. In states where the township or town form predominates, the township or town is the unit of assessment. In either case, the work is generally done by locally elected officials.

In a small group of states the assessment made by local officials is reviewed first by a township board of review or by a city or town council. In practically all states there is a county board of review, with varying degrees of power and authority. This county board of review is generally the county board of supervisors, board of county commissioners, or a similar body. The point is that township, town, city, and county boards of review are composed of locally elected officials, who devote very little time to the work of correcting assessments made by other locally elected officials. It would be difficult to conceive of a more antiquated, inefficient, wasteful, and impractical method of transacting an important public business than the plan thus outlined; and yet practically all states cling tenaciously to this pioneer system, largely because of faith in local self-government and the fear of administrative centralization and appointed officials.

The modern state tax board or commission has been assuming the leadership in an effort to place the work of assessment on a more efficient and equitable basis, but only a good beginning has been made. Where the township has been performing the work of assessment, nearly all efforts to substitute the county as the unit of assessment have met with failure. No better success has attended the substitution of appointed officials for locally elected assessors. The power vested in certain state tax boards actually to reassess the property of a given taxing district and more efficient supervision of the work of assessment are tending to improve methods of assessment. Whatever the method, the goal is uniform assessment, without which equality and uniformity of taxation are not possible.

By assessment is meant a process of listing and valuing all classes of property subject to taxation under either a general property tax or some form of a classified property tax. The definition of this term raises the great central question of economic value, which is and always has been the cornerstone of economic science.

What is meant by the value of any economic good or economic service? The courts generally hold that value for purposes of taxation means value on the market in the ordinary course of trade and neither at a forced sale nor under the influence of speculative manipulation. The terms "actual value," "true value," "real value," "cash value," "actual worth in money," and many other phrases will be found in the tax laws of the

different states. In the last analysis they all mean substantially the same thing and that is ordinary, normal, market value. Earnings, condition of the roads, availability of good markets, educational and recreational advantages, the amount of rainfall and other climatic conditions, sentiment, and numerous other factors are elements which determine value.

Perhaps too much attention has been paid in the past to "sale or market value" as that term is used by tax commissions and courts, and not enough attention has been given to the average earnings obtained from different classes of taxable property over a period of years. It is out of earnings that taxes ought to be paid. To the extent that this is not done, the inevitable tendency will be to pay taxes out of capital, and by so doing dry up the very source of future income. Average earnings, therefore, under varying conditions of prosperity and depression, should constitute the primary factor in arriving at the assessed value of property for purposes of taxation. When this is done more attention can be directed to the really serious problem of uniformity of assessment.

If the capitalization of average net earnings over a period of years at the rate of 6 per cent is used as a basis of judgment, it is doubtful whether there has been any serious underassessment of different classes of taxable property in the majority of the states. The alleged underassessment, especially of real estate, has probably been greatly exaggerated not only by writers on public finance, but also in a great many tax commission reports. The important question relates to the gross inequalities of assessment that prevail in the average state.

The levy of a tax by national, state, or local authority is a legislative function in contrast with the work of assessment, which is a problem of administration. Assessors do not levy taxes. They value property, thus determining the basis upon which the tax levy is made by town selectmen, township trustees, city councils, school boards, county boards of supervisors, and the state legislature itself.

Income Taxes. The second form of taxation is that on income. Income may be received from property or from personal service or both. If the tax is levied only on the personal income of individuals it is a personal income tax. If the tax is levied on the net income of corporations it is frequently called a business income tax. If the tax includes both, it is a general income tax.

A special income tax on certain classes of income is levied in Massachusetts.

The income tax is important in highway finance because so large a part of the revenue of the federal government is derived from that source, and out of the fund obtained in part from this source appropriations have been voted for federal aid for highway construction.

A number of states, such as Wisconsin, New York, and Massachusetts, obtain part of their state revenue from this same source. Any state aid for the construction and maintenance of public highways, therefore, may come partly from the income tax.

Business Taxes.—The third form of taxation is on business, including import duties, export duties, various taxes on interstate commerce which may be levied by the federal government but not by the states, taxes on the processes of manufacturing, sales taxes of various kinds, gross earnings taxes; stock and bond taxes, and license taxes on the right to carry on certain lines of business or own and operate certain classes of property. A considerable part of the federal revenue is obtained from business taxes, and out of this revenue federal aid is appropriated for the improvement of the public highways. The several forms of license taxes on motor vehicles and the gasoline tax are forms of business taxation.

Inheritance Taxes.—Inheritance taxes imposed in connection with the transfer of property at death, or in anticipation of death, supply a certain amount of revenue to practically every state in the Union and also the federal government. These taxes, therefore, supply a part of the revenue for the construction and maintenance of roads and bridges.

Poll Tax.—One of the earliest forms of taxation for road purposes was the poll tax. This is one class of taxes levied on persons as contrasted with property, income, business, or the transfer of property. A typical example of a personal tax is the road poll tax, which still obtains in a number of our states.

Bonds.—In the foregoing classification of public revenue, and in the subclassification of taxes, no mention is made of bonds as a form of public revenue. The omission of bonds as a source of revenue for road purposes is intentional because it is agreed that as Professor Adams holds, a public debt is from its very nature anticipatory revenue and not revenue obtained directly from the public domain or public industries or derived from

special assessments, fees, or taxes. Professor Adams writes as follows:

In addition to direct and derivative revenues a state may secure funds through the use of its credit; that is to say, it may borrow money. This revenue is properly characterized as anticipatory revenue. It is secured through the creation of a debt, and in a sound system of finance is recognized as the first step toward an increase in taxes or a higher return from public property or public industry. Public credit as a source of income to the state cannot be understood except one is familiar with the principles that control direct and derivative revenue. Its legitimate use is confined to making headway against a fiscal exigency or to the providing of capital for public investment. These are both unusual conditions. The advent of an expensive war may constitute a fiscal exigency and justify the use of public credit. The policy of building a great system of canals or railways may be accepted as an example of what is meant by the investment of public capital, and the capital for investment will in all probability be secured by the sale of bonds. In both classes of cases the occasion of the expenditure is out of the ordinary. In neither is the revenue secured as final revenue, but carries with it the necessity of securing an equal amount at some time in the future with which to pay back the money borrowed. It is thus evident that anticipatory revenue is different in its nature and its use from ordinary revenue, and that for this reason it should receive separate consideration.[1]

MOTOR-VEHICLE TAXES

Nature of Motor Vehicle Taxes.—Three-fourths of the states list, assess, and tax motor vehicles as personal property. There is no way of determining the magnitude of this tax as compared with various license taxes and gasoline taxes in those same states. It is quite certain, however, that the revenue obtained from motor vehicles as property is not large in comparison with the revenue derived from various business taxes, including those imposed by the federal government as well as the states. In Delaware, Idaho, Iowa, Michigan, Minnesota, New Hampshire, New York, North Dakota, Oklahoma, Oregon, Pennsylvania, and Vermont, motor vehicles are not assessed as personal property, which means that certain business taxes imposed are in lieu of all other taxes.

Aside from the personal property tax, all other taxes, both state and federal, levied on motor vehicles come under the general heading of business taxes. The gasoline tax is a sales tax and may be imposed on the act of retailing or wholesaling gaso-

[1] ADAMS, "The Science of Finance," pp. 220–221, 1912.

line, subject to the limitation, however that states have no constitutional right to tax interstate commerce. License taxes, or license fees as they are frequently called, are taxes on the right or privilege of owning and operating a motor vehicle for pleasure or for commercial gain.

War Revenue Act, 1917.—In addition to the revenue obtained by the various states from gasoline taxes and license taxes on motor vehicles, the federal government has collected from this same general source a sum in excess of that appropriated for federal aid for highways. Under the War Revenue Act approved Oct. 3, 1917, there was imposed a sales tax of 3 per cent on all sales by producers, manufacturers, or importers of all automobiles, automobile trucks, automobile wagons, and motor cycles.[1]

Amendments, 1919.—In 1919 this provision of law was amended to read as follows:

> That there shall be levied, assessed, collected, and paid upon the following articles sold or leased by the manufacturer, producer, or importer, a tax equivalent to the following percentages of the price for which so sold or leased:
>
> 1. Automobile trucks and automobile wagons (including tires, inner tubes, parts, and accessories therefor, sold on or in connection therewith or with the sale thereof) 3 per centum.
>
> 2. Other automobiles and motor cycles (including tires, inner tubes, parts, and accessories therefor, sold on or in connection therewith or with the sale thereof), except tractors, 5 per centum.
>
> 3. Tires, inner tubes, parts, or accessories, for any of the articles enumerated in subdivision (1) or (2), sold to any person other than a manufacturer or producer of any of the articles enumerated in subdivision (1) or (2), 5 per centum.[2]

The Revenue Act of 1921 continued this same provision of the law without change in rate,[3] but in 1926 all these taxes were repealed, except that item (2) was reduced to 3 per centum.

Statistical Data.—Table V shows the federal revenue obtained from motor vehicles under the War Revenue Act of 1917 and as amended in 1919. The total revenue produced for the fiscal years 1918 to 1924 inclusive was $714,265,534.07.

The total amount of federal aid for highways during this same period was $315,796,003.05, or less than 45 per cent of the amount collected in federal taxes on motor vehicles and accessories.

[1] "United States Statutes at Large," vol. 40, Part I, p. 31.

[2] *Ibid.*, p. 1122.

[3] *Ibid.*, Part I, vol. 42, p. 291.

ROAD REVENUES AND EXPENDITURES

The Office of Public Roads in 1904 published a report giving the mileage of improved and unimproved country roads and the expenditures on roads and bridges from property taxes, poll taxes, bond issues, state aid, and the amount and value of the labor expended under statute labor laws. This is summarized in Table VI.

Road Taxes.—Much of the controversy over the improvement of roads centers around the rate of tax levy. It is natural for

TABLE V.—FEDERAL REVENUE FROM MOTOR VEHICLES[1]

	Automobile trucks and automobile wagons, 3 per cent	Other automobiles and motor cycles, 5 per cent	Tires, parts, or accessories for automobiles, 5 per cent	Automobiles, motor cycles, etc., 3 per cent	Total
1918	. . . . .	. . .		23,981,268.35	23,981,268.35
1919	. . . . .	. . .		24,076,261.97	24,076,261.97
1920	14,471,464.32	76,315,814.26	53,135,513.43	. . . . .	143,922,792.01
1921	11,640,055.92	64,388,184.22	39,518,009.17	. . . . .	115,546,249.31
1922	8,404,557.85	56,684,540.30	39,344,664.60	. . . . .	104,433,762.75
1923	10,678,761.05	92,736,580.44	40,875,148.79	. . . . .	144,290,490.28
1924	11,510,563.05	112,870,536.57	33,633,609.78	. . . . .	158,014,709.40
Total	56,705,402.19	402,995,655.79	206,506,945.77	48,057,530.32	714,265,534.07

[1] *Reports* of Federal Treasury and Director of the Budget.

people to object to an increase in the tax rate even though made necessary by expenditures that are justified by benefits received. Table VII shows the rate of road levy per $100 of assessed valuation in 1904. Maximum, minimum, and average rates of levy are shown for each state and territory except in states where no specific road tax is levied by the county. The methods of levying taxes are necessarily different in the several states as already explained. In New England the towns exercise large authority in such matters. In states such as Ohio and Indiana taxes are levied by the county as well as by the civil township.

Table VIII shows the road mileage, road income, and other related data for the United States for 1921, 1914, 1909, and 1904. Small as is the surfaced mileage when compared with the total mileage of the country at large, it was still sufficient in 1921 to supply the United States with seventy-five east-and-west routes extending from ocean to ocean, and an equal number extending north and south from the Canadian border to Mexico and the

Gulf. It is also encouraging to record the fact that surfaced mileage increased from 7.1 per cent in 1904 to 13.2 per cent in 1921. Table IX shows the total income for all rural road purposes in 1921, consolidated for all states, counties, townships, and districts. It will be recalled that the construction and maintenance of public highways involved the income and expenditure of public funds not only by states and counties, but also by townships and certain subordinate road improvement districts which differ in different commonwealths. This table will reveal the many different sources of public revenue for road purposes. The total sum available in the states for road purposes was $1,149,437,896. The fund obtained from bond sales, which includes not only receipts from the sale of highway bonds in 1921 but also all cash from previous bond sales on hand at the beginning of the year, is the largest single item, amounting to 38.1 per cent of the total. The general property taxes contribute 36.2 per cent. Federal and forest-road aid supplied 6.9 per cent; motor vehicle fees and gasoline taxes amounted to 10.6 per cent; and all other sources furnished 8.2 per cent. The revenue from general property taxes would equal and possibly exceed that obtained from bond sales if it were known what portion of the $93,681,221 that is listed as from miscellaneous sources should be credited to the general property tax.

Total Expenditures.—Table XI gives the total expenditures for all rural highway purposes in 1921, consolidated for all states, counties, townships, and districts. This table shows the distribution of the funds to the various classes of highway work.

DISTRIBUTION OF THE TAX BURDEN

In most states having permanent state tax commissions and progressive tax legislation, statistical data are compiled showing the distribution of the tax burden. The amount of revenue obtained from different classes of taxes, the relative amount levied for such purposes as schools and the public highways, and the relative amount of taxes levied by the different taxing districts from the state down, are among the essential facts which ought to be made known in order that the highway engineer may adjust his program to the financial condition of the political unit he serves.

North Dakota.—Statistical data from any one of a number of states would illustrate the principles involved. Table X shows

TABLE VI.—PUBLIC-ROAD MILEAGE AND EXPENDITURES IN THE UNITED STATES IN 1904[1]

State	Miles of all public roads			Miles of improved roads				
	Total mileage	Miles of road per square mile of area	Population per mile of road	Surfaced with gravel	Surfaced with stone	Surfaced with other materials	Total mileage of improved roads	Percentage of all roads improved
Alabama	50,089	0.97	36	1,261.5	392.5	66	1,720	3.43
Arizona	5,987	0.05	20	216	1	0	217	3.62
Arkansas	36,445	0.67	36	181	55	0	236	0.64
California	46,653	0.29	31	5,843.5	418.5	2,541	8,803	18.87
Colorado	30,214	0.30	17	121	57	0	178	0.58
Connecticut	14,088	2.90	64	1,896.5	463.6	0	2,360.1	16.75
Delaware	3,000	1.53	61	2	14	50	66	2.20
Dist. of Columbia	191	3.18	1,459	70	61	0	131	68.58
Florida	17,374	0.34	30	17.5	345	523	885.5	5.09
Georgia	57,203	0.96	38	659	438	537	1,634	2.85
Idaho	18,163	0.20	9	195	17	0	212	1.16
Illinois	94,141	1.60	51	6,800	1,106.5	17.5	7,924	8.41
Indiana	68,306	1.90	36	20,582	3,295	0	23,877	34.94
Iowa	102,448	1.84	21	1,403	241	20	1,664	1.62
Kansas	101,196	1.20	14	158.5	111.7	3	273.2	1.26
Kentucky	57,137	1.40	37	1,408	8,078	0	9,486	16.60
Louisiana	24,897	0.54	55	26	0	8	34	0.13
Maine	25,528	0.85	27	2,236	87.5	0	2,323.5	9.10
Maryland	16,773	1.70	70	480	840	250	1,570	9.36
Massachusetts	17,092	2.12	164	6,621	1,213	10	7,844	45.89
Michigan	69,296	1.20	35	6,777	248.5	0	7,025.5	10.13
Minnesota	79,324	1.00	22	6,179	67.5	1	6,247.5	7.87
Mississippi	38,698	0.83	40	109	0	40	149	0.38
Missouri	108,133	1.50	28	1,871.5	861.5	0	2,733	2.52
Montana	22,419	0.15	10	65	0	0	65	0.28
Nebraska	79,462	1.00	13	0	17	6	23	0.02
Nevada	12,585	0.11	3	60	4	0	64	0.50
New Hampshire	15,116	1.67	27	1,175	118	0	1,293	8.55
New Jersey	14,842	1.97	127	481.5	1,901	40	2,422.5	16.32
New Mexico	15,326	0.12	12	2	0	0	2	0.01
New York	73,798	1.54	98	3,692	2,184	0	5,876	7.96
North Carolina	49,763	1.00	38	422	399	438	1,259	2.52
North Dakota	59,332	0.84	5	205	7	0	212	0.35

Ohio	69,439	1.79	59	16,159	7,160.5	140.5	23,460	33.78
Oklahoma	43,554	1.10	9	0	0	0	0	0
Oregon	34,258	0.36	12	2,235	209	145	2,589	7.55
Pennsylvania	99,777	2.21	63	0	2,161	0	2,161	2.10
Rhode Island	2,361	2.24	181	774.5	247	0	1,021.5	43.26
South Carolina	41,830	1.30	32	179	69	1,630	1,878	4.48
South Dakota	59,295	0.70	7	147	4	0	151	0.25
Tennessee	48,989	1.17	41	2,511	1,774	0	4,285	8.74
Texas	121,409	0.46	25	167	1,909	52	2,128	1.75
Utah	7,090	0.08	39	597	11	0	2,608	8.57
Vermont	14,521	1.58	23	1,672.5	281	0	1,953.5	13.45
Virginia	51,812	1.29	35	720	755	125	1,600	3.08
Washington	31,998	0.48	16	1,928	48.5	0	1,976.5	6.17
West Virginia	26,178	1.06	36	26.5	217	11	254.5	0.97
Wisconsin	63,593	1.17	33	9,900	733.2	0	10,633.2	16.72
Wyoming	10,447	0.10	8	0	0	153	153	1.46
United States	2,151,570	0.73	35	108,233	38,622	6,807	153,662	7.14

TABLE VI.—PUBLIC-ROAD MILEAGE AND EXPENDITURES IN THE UNITED STATES IN 1904.—*(Continued)*

State	Expenditures						
	By counties, townships, and districts			By states on state-aid roads	Total	Per mile of public road	Per inhabitant
	From property and poll taxes payable in cash[a]	From labor taxes[b]	From bond issues				
Alabama	$ 378,039.77	$ 1,198,394.50	.....	.....	$ 1,576,434.27	$ 31.47	$0.86
Arizona	67,591.43	41,718.00			109,309.43	18.25	0.89
Arkansas	681,933.80	713,409.00	.....	.....	1,395,342.80	38.28	1.06
California	2,146,145.36	.....	.....	$ 11,251.00	2,157,396.36	46.24	1.45
Colorado	601,060.63	71,828.00		34,335.00	707,223.63	23.40	1.31
Connecticut	975,960.01			219,165.00	1,195,125.01	84.83	1.32
Delaware	76,802.88	.....	.....	14,000.00	90,802.88	30.26	0.49
District of Columbia	176,000.00				176,000.00	921.46	0.63
Florida	437,184.10	140,393.00	.....	.....	577,577.10	33.24	1.09
Georgia	894,936.33	1,185,936.00	.....	.....	2,080,872.33	36.37	0.93
Idaho	201,648.00	109,940.00			311,588.00	17.15	1.92
Illinois	[d]3,844,423.73	[c]366,526.50	.....	.....	4,210,950.23	44.73	0.87
Indiana	[d]2,095,970.30	[c]896,718.75	$1,342,418.95	.....	4,335,108.00	63.46	1.72
Iowa	[d]2,344,166.56	762,501.00			3,106,667.50	30.32	1.39
Kansas	[d]692,823.45	[c]539,994.00	.....	.....	1,232,817.45	12.18	0.83
Kentucky	[d]1,161,194.03	987,495.00	.....	.....	2,148,689.03	37.60	1.00
Louisiana	345,451.86	606,421.00	.....	.....	951,872.86	38.23	0.68
Maine	1,427,508.21	.....	.....	44,885.49	1,472,393.70	57.67	2.12
Maryland	873,470.50	.....	.....	.....	873,470.50	52.07	0.73
Massachusetts	2,295,616.48			575,605.99	2,871,222.47	167.98	1.02
Michigan	[d]1,816,504.21	[c]1,362,283.67			3,179,787.88	15.88	1.31
Minnesota	[d]1,542,641.99	[c]354,212.25	64,775.00	.....	1,961,629.24	24.72	1.12
Mississippi	339,669.45	1,335,816.00	.....	.....	1,675,485.45	43.29	1.08
Missouri	[d]1,570,801.29	798,171.50	.....	.....	2,368,972.79	21.90	0.76
Montana	308,743.81	95,354.00	.....	.....	404,097.81	18.02	1.66
Nebraska	[d]494,886.40	383,661.00	.....	.....	878,547.40	11.05	0.82
Nevada	46,875.85				46,875.85	3.72	1.10
New Hampshire	858,606.35			14,000.00	872,606.35	57.72	2.12
New Jersey	3,024,811.25	.....	.....	250,000.00	3,274,811.25	220.64	1.73
New Mexico	35,457.56	130,194.00	.....	.....	165,651.56	10.80	0.84
New York	2,881,268.99	1,754,785.83	.....	1,056,460.00	5,692,514.82	77.05	0.79
North Carolina	624,380.78	734,306.45	.....	.....	1,358,687.23	27.30	0.71

North Dakota	[d]456,130.22	[e]94,210.50	.....	.....	550,340.72	9.28	1.72
Ohio	[d]3,932,563.97	[e]929,766.00	843,753.64	.....	5,706,083.61	82.17	1.37
Oklahoma	[d]447,319.59	[e]327,456.00	.....	.....	774,775.59	17.79	1.94
Oregon	649,717.97	146,658.00	.....	.....	796,375.97	23.24	1.92
Pennsylvania	[d]4,759,499.16	.....	.....	127,766.52	4,887,265.68	48.98	0.77
Rhode Island	297,414.71	.....	.....	79,397.45	376,812.16	171.44	0.94
South Carolina	334,081.90	411,619.60	.....	.....	745,701.50	17.82	0.55
South Dakota	[d]268,722.57	[e]114,560.50	.....	.....	383,283.07	6.46	0.95
Tennessee	386,013.85	892,635.75	343,127.55	.....	1,621,777.15	33.10	0.80
Texas	1,607,216.70	[e]1,594,545.00	936,395.70	.....	4,138,157.49	34.08	1.35
Utah	135,210.78	60,390.00	.....	23,075.00	218,675.78	30.84	0.79
Vermont	440,016.12	.....	.....	127,381.21	567,397.33	39.07	1.65
Virginia	687,751.06	.....	.....	.....	687,751.06	13.27	0.37
Washington	1,344,842.19	91,228.00	.....	.....	1,436,070.19	44.88	2.77
West Virginia	[d]587,870.28	[e]305,415.00	.....	.....	893,285.28	34.12	0.93
Wisconsin	[d]1,924,025.88	[e]257,236.50	.....	.....	2,181,262.38	34.30	1.05
Wyoming	[f]324,475.73	[e]21,456.00	.....	.....	345,931.73	9.45	1.04
United States[g]	$53,815,387.98	$19,818,236.30	$3,530,470.93	$2,607,322.66	$79,771,417.87	$ 37.07	$1.05

[a] This column includes property taxes and poll taxes payable in cash. In some States, however, property taxes may be worked out, and where such is the case reference has been made to the explanatory footnote [d]. It has been impossible to ascertain the extent to which such taxes were actually paid in labor instead of in cash.

[b] This column includes labor taxes and poll taxes payable in labor. In some States, however, the statutes permit the payment of labor taxes in cash, and where such is the case reference has been made to the explanatory footnote [e]. It has been impossible to ascertain what part of these taxes were so paid.

[c] One-half the cost of road construction and repair in the District of Columbia is paid from Congressional appropriation, the other half by the District out of the general revenues from taxation of property.

[d] Part of this amount was paid in labor instead of in cash, as provided for by law in this State. (See footnote [a].)

[e] Part of this amount was paid in cash instead of in labor, as provided for by law in this State. (See footnote [b].)

[f] Of this amount $250,000 was expended for roads in Yellowstone National Park. This sum was appropriated by Congress and expended under the direction of a United States Army engineer.

[g] Exclusive of Indian Territory, Alaska, and island possessions.

[h] U. S. Department of Agriculture, Office of Public Roads, *Bull.* 32, "Public-road Mileage, Revenues, and Expenditures in the United States," pp. 8–9, 1904.

TABLE VII.—RATE OF ROAD LEVY PER $100 OF ASSESSED VALUATION IN 1904[1]

State	Maximum	Minimum	Average
Alabama	$0.25	$0.10	$0.175
Arizona	0.25	0.10	0.181
Arkansas	0.30	0.20	0.290
California	0.60	0.21	0.378
Colorado	0.85	0.05	0.362
Connecticut	(a)	(a)	(a)
Delaware	0.35	0.15	0.270
Florida	0.60	0.075	0.303
Georgia	0.20	0.05	0.161
Idaho	0.75	0.10	0.251
Illinois	(b)	(b)	(b)
Indiana			
Iowa	0.50	0.10	0.397
Kansas	0.50	0.025	0.272
Kentucky	0.31	0.05	0.199
Louisiana			
Maine	0.58	0.30	0.436
Maryland	0.84	0.013	0.254
Massachusetts	(a)	(a)	(a)
Michigan	(b)	(b)	(b)
Minnesota	(b)	(b)	(b)
Mississippi	0.30	0.05	0.100
Missouri	0.30	0.05	0.156
Montana	0.30	0.05	0.190
Nebraska	0.60	0.03	0.215
Nevada	0.25	0.05	0.130
New Hampshire	0.603	0.25	0.423
New Jersey	(b)	(b)	(b)
New Mexico	0.20	0.025	0.078
New York	(b)	(b)	(b)
North Carolina	0.40	0.05	0.188
North Dakota	1.30	0.12	0.444
Ohio	(b)	(b)	(b)
Oklahoma	(b)	(b)	(b)
Oregon	1.00	0.10	0.372
Pennsylvania	(b)	(b)	(b)
Rhode Island	(a)	(a)	(a)
South Carolina	0.20	0.025	0.118
South Dakota	0.50	0.05	0.227
Tennessee	0.20	0.08	0.108
Texas	0.30	0.02	0.149
Utah	(d)	(d)	(d)
Vermont	(a)	(a)	(a)
Virginia	0.50	0.10	0.237
Washington	1.60	0.30	0.738
West Virginia	0.45	0.05	0.258
Wisconsin	(b)	(b)	(b)
Wyoming	0.21	0.075	0.171
Average levy for all counties reporting	.....	.....	$0.257

[1] *Ibid.*, p. 19.

[a] No separate levy is made for roads, money for this purpose being appropriated by the town meetings out of the general fund raised for all purposes.

[b] In this State the levy varies in the different townships.

[c] The total amount of property tax which one person may be required to pay is limited to $15.

[d] Counties in this State make no specific levy, money for road purposes being apportioned by county commissioners out of the general fund.

the distribution of the tax levy of 1923 for the state of North Dakota.

New York.—The distribution of all state and local taxes levied in the great state of New York in the calendar year of 1923, as placed at the disposal of the various classes of jurisdiction,

TABLE VIII.—ROAD MILEAGE, ROAD INCOME, AND OTHER RELATED DATA FOR THE UNITED STATES IN 1921, 1914, 1909, AND 1904[1]

	1921	1914	1909	1904
Total road mileage	2,941,294	2,445,761	2,199,645	2,151,379
Surfaced mileage	387,760	257,291	190,476	153,530
Percentage surfaced	13.2	0.5	8.7	7.1
Total income for all rural road purposes	$1,149,437,896	[a]$240,263,784	[b]	$79,623,617
State and local road and bridge bonds outstanding at end of year	$1,222,312,300	$344,763,082	[b]	[b]
Land area (square miles)	2,973,714	2,973,830	2,973,830	2,974,099
Population, total for United States	[c]105,273,049	[d]91,641,197	[d]91,641,197	[e]75,715,857
Rural population	[c]51,406,017	[d]49,348,883	[d]49,348,883	[e]45,197,390
Miles of road per square mile of area	0.99	0.82	0.74	0.72
Miles of road per 1,000 of rural population	57.2	49.5	44.6	47.6
Surfaced mileage per square mile of area	0.130	0.086	0.064	0.052
Surfaced mileage per 1,000 of rural population	7.54	5.21	3.86	3.39
Road and bridge income per mile of road	$390.79	$98.22	[b]	$37.01
Road and bridge income per square mile of area	$386.52	$80.79	[b]	$26.77
Road and bridge income per capita	$10.92	$2.62	[b]	$1.05

[a] Income considered as equal to expenditure.
[b] No data available.
[c] 1920 census.
[d] 1910 census.
[e] 1900 census.
[1] U. S. Department of Agriculture, *Bull.* 1279, "Rural Highway Mileage, Income, and Expenditures," p. 10, 1921 and 1922.

may be briefly summarized. The official report in this case shows the distribution of taxes, first, as between the different kinds of taxation, and second, as between the different taxing districts of the state. The total levy for all purposes, state and local, was $632,263,876.11, a sum larger than the entire revenue of our federal government only a very few years ago. Of this sum, $482,727,335.23 was obtained from the general property tax alone. Thus it appears that, in spite of all the special forms of taxation that have developed in the Empire State during the last quarter-century, the general property tax still supplies slightly more than 75 per cent of all the revenue needed for state and local purposes.

TABLE IX.—TOTAL INCOME FOR ALL RURAL ROAD PURPOSES IN 1921[1]

Geographic divisions and states	Total	Bonds[a]	Per cent of total	Federal and forest road aid[b]	Per cent of total	Motor-vehicle fees[c]	Gasoline taxes	Per cent of total	General property taxes	Per cent of total	All other sources	Per cent of total
Entire United States	$1,140,427,899	$428,109,273	38.1	$79,333,226	6.9	$118,942,706	$3,683,460	10.6	$415,681,010	36.2	$93,681,221	8.2
New England	49,477,284	5,889,745	12.7	2,904,686	6.2	11,629,091	.....	25.1	17,428,085	37.5	8,603,677	18.5
Maine	7,847,846	1,766,960	22.4	852,192	10.8	1,004,750	.....	12.7	2,279,722	28.9	1,987,216	25.2
New Hampshire	3,882,488	197,316	5.8	240,782	6.2	790,118	.....	20.4	1,231,877	31.7	1,512,295	38.9
Vermont	2,143,355	199,472	4.7	135,289	6.3	627,588	.....	29.3	1,055,941	49.3	224,063	10.4
Massachusetts	19,200,095	2,545,015	17.3	661,594	3.4	5,023,963	.....	26.1	9,139,616	47.5	1,108,883	5.7
Rhode Island	3,524,097	286,100	8.6	358,374	10.7	777,587	.....	23.4	866,867	26.1	1,035,019	31.2
Connecticut	9,044,227	295,824	3.0	656,455	6.6	3,405,085	.....	34.2	2,854,062	28.7	2,736,201	27.5
Middle Atlantic	168,867,443	59,543,258	35.4	7,441,515	4.4	22,340,418	.....	13.3	59,773,811	35.5	19,206,431	11.4
New York	67,319,530	18,355,231	27.2	2,398,461	3.6	[d]9,000,000	.....	13.4	[d]36,300,000	53.9	1,305,638	1.9
New Jersey	21,657,854	7,183,444	33.2	509,372	2.4	4,029,971	.....	18.6	8,742,624	40.2	1,192,423	5.6
Pennsylvania	79,888,059	34,004,583	42.9	4,533,682	5.7	9,310,447	[e]	11.7	14,731,187	18.6	[d]16,708,370	21.1
East North Central	281,139,024	101,550,318	35.9	11,887,887	4.2	27,432,261	.....	9.8	116,541,291	41.7	23,727,267	8.4
Ohio	82,275,668	32,809,752	39.9	3,595,383	4.4	7,044,751	.....	8.6	32,268,341	39.2	6,497,441	7.9
Indiana	57,807,614	28,709,037	49.7	1,446,623	2.5	2,305,312	.....	4.0	23,455,017	40.6	1,891,625	3.2
Illinois	43,661,781	11,297,671	25.9	3,802,430	8.7	6,862,126	.....	15.7	18,350,639	42.0	3,351,918	7.7
Michigan	55,092,357	20,669,926	37.1	599,854	1.1	7,795,926	.....	14.0	20,228,619	36.4	6,368,332	11.4
Wisconsin	41,728,604	8,064,232	19.2	2,443,597	5.8	3,424,146	.....	8.2	22,238,673	53.3	5,617,951	13.5
West North Central	155,642,716	34,291,178	22.3	14,636,169	9.5	20,745,538	.....	13.4	71,403,600	48.5	9,737,231	6.3
Minnesota	40,357,925	8,731,150	21.6	2,986,920	7.4	5,616,114	.....	13.9	20,892,168	51.8	2,131,573	5.3
Iowa	37,991,782	9,406,869	24.8	4,308,079	11.3	7,211,922	.....	19.0	14,878,638	39.2	2,186,274	5.7
Missouri	16,494,875	3,426,429	20.8	2,304,790	14.0	2,506,354	.....	15.2	5,140,186	31.1	3,118,225	18.9
North Dakota	6,715,400	.....	.....	584,685	8.7	418,525	.....	6.2	5,349,252	79.7	362,938	5.4
South Dakota	15,248,232	3,607,644	19.7	1,650,139	10.8	648,528	.....	4.3	9,379,184	61.5	562,446	3.7
Nebraska	13,446,782	2,242,484	16.6	1,200,000	9.0	2,820,000	.....	21.0	6,448,008	47.9	736,290	5.5
Kansas	25,387,620	7,476,611	32.0	1,601,565	6.8	1,454,095	.....	5.8	12,315,864	52.7	629,185	2.7
South Atlantic	137,657,698	67,406,730	49.0	11,267,126	8.2	11,126,923	734,075	8.6	39,213,111	28.4	7,909,100	5.8
Delaware	5,487,318	3,157,776	57.6	244,343	4.4	175,171	.....	6.8	179,729	3.3	1,530,029	27.9
Maryland	10,725,960	3,524,299	32.9	850,000	7.9	1,600,000	.....	14.9	4,198,312	42.0	253,349	2.3
Virginia	17,832,143	5,519,711	30.9	980,806	5.5	1,926,624	.....	10.7	5,687,720	32.0	[d]3,717,282	20.9
West Virginia	27,237,475	18,775,066	69.1	1,057,652	3.8	1,938,000	.....	7.1	5,118,257	19.8	48,500	0.2
North Carolina	32,841,625	17,640,534	53.6	2,671,070	8.1	2,322,630	506,019	8.6	8,357,346	25.6	1,341,026	4.1
South Carolina	14,261,209	8,146,630	57.2	1,359,453	9.5	692,663	.....	4.8	3,749,525	26.3	312,938	2.2
Georgia	17,332,046	4,500,281	26.1	3,610,524	20.4	1,600,000	.....	9.3	7,358,512	42.7	262,729	1.5
Florida	11,939,922	6,142,433	51.5	490,308	4.1	671,535	228,056	7.5	3,964,043	33.2	443,547	3.7

East South Central	60,280,684	25,551,347	42.5	5,281,475	8.7	4,670,271	438,116	8.5	20,155,466	33.3	4,184,009	7.0
Kentucky	11,528,264	485,000	4.2	1,482,066	12.9	1,685,769	438,116	18.4	5,380,814	46.7	2,056,499	17.8
Tennessee	16,443,936	8,446,353	51.4	1,685,453	10.3	1,386,378	.....	8.4	4,276,784	26.0	648,968	3.9
Alabama	6,569,567	1,878,316	28.3	477,590	7.3	893,136	.....	13.6	2,419,876	37.0	900,739	13.8
Mississippi	25,738,917	14,741,678	57.3	1,636,366	6.3	704,988	.....	2.7	8,078,072	31.4	577,803	2.3
West South Central	138,504,160	82,127,751	59.3	10,929,721	7.9	7,326,965	170,000	5.4	31,461,989	22.8	6,487,734	4.6
Arkansas	22,886,970	16,060,289	70.2	1,372,205	6.0	856,544	[d]170,000	4.5	4,266,391	18.6	161,541	0.7
Louisiana	23,230,916	15,831,986	68.1	1,424,114	6.1	453,276	.....	2.0	4,237,084	18.3	1,284,456	5.5
Oklahoma	19,516,915	5,273,327	27.0	2,345,354	12.0	2,263,006	.....	11.6	9,348,121	47.9	287,107	1.5
Texas	72,869,359	44,962,149	61.7	5,788,048	8.0	3,754,139	.....	5.1	13,610,393	18.7	4,754,630	6.5
Mountain	61,367,959	19,908,036	32.4	9,731,542	15.8	3,412,764	892,760	7.0	22,292,642	36.5	5,130,215	8.3
Montana	10,031,901	3,330,829	33.2	2,041,172	20.4	546,150	.....	5.4	2,392,404	33.8	1,721,346	17.2
Idaho	13,113,443	6,221,802	47.4	1,539,045	11.8	811,398	.....	6.2	4,463,160	34.0	78,038	0.6
Wyoming	5,408,879	700,000	12.9	1,318,764	24.4	290,000	.....	5.4	1,959,663	36.2	1,140,452	21.1
Colorado	8,765,443	250,000	2.9	1,493,369	17.0	820,316	559,472	15.7	5,545,743	63.3	96,543	1.1
New Mexico	4,896,667	830,000	17.0	1,093,208	22.3	188,593	333,288	10.6	2,427,209	49.6	24,369	0.5
Arizona	10,299,916	5,504,825	53.4	816,681	7.9	180,633	[h]	1.8	2,434,201	23.6	1,363,576	13.3
Utah	6,560,366	2,495,580	38.1	862,712	13.2	478,474	.....	7.3	2,421,823	36.8	301,777	4.6
Nevada	2,291,344	575,000	25.0	566,591	24.8	97,200	.....	4.2	648,439	28.4	404,114	17.6
Pacific	102,084,938	41,840,910	41.0	5,253,105	5.1	10,429,475	1,448,509	11.6	34,410,682	33.7	8,702,257	8.6
Washington	23,860,219	4,914,339	20.6	537,794	2.3	3,375,600	500,000	16.2	12,718,071	53.3	1,814,415	7.6
Oregon	28,532,824	13,908,032	48.8	2,181,957	7.6	2,184,275	948,509	11.0	6,260,046	21.9	3,050,005	10.7
California	49,691,895	23,018,539	46.3	2,533,354	5.1	4,869,600	.....	9.8	15,432,565	31.1	3,837,837	7.7

[a] Includes all receipts from sale of highway bonds during 1921 and all cash from previous bond sales on hand at beginning of the year.
[b] Includes only Federal aid and national forest payments received by the States and credited by them to their respective highway funds during the fiscal year.
[c] Does not correspond with receipts from motor vehicles during registration year, as shown on Table 17, because of differences in fiscal years and time of transfer to road funds.
[d] Approximate.
[e] Gasoline tax effective Sept. 1, 1921.
[f] Appropriations, $12,120,000
[g] Includes $1,846,310 State appropriations.
[h] Gasoline tax approved Mar. 17, 1921, but no funds credited to State highway fund prior to end of fiscal year, June 30, 1921.
[i] U. S. Department of Agriculture, *Bull.* 1279, "Rural Highway Mileage, Income, and Expenditures," pp. 11 12, 1921 and 1922.

Other forms of taxation producing substantial amounts of revenue are: the personal income tax, $37,809,134.62; the franchise tax on business corporations, both domestic and foreign, $22,621,977.19; and the inheritance tax, $18,546,696.02. The sum of $7,640,300.08 was received from a stock transfer tax. Of this tax revenue the state receives $129,976,654.12; the counties, $43,254,799.83; the cities $390,434,880.23; the towns, $27,656,536.04; the villages, $13,615,559.86; and the school districts, $27,325,446.03.[1]

Ordinary Revenue.—It will be recalled that bonds do not represent ordinary revenue comparable to taxes and special assessments, but anticipatory revenue which must be secured by increasing ordinary revenue over a period of years.

To think clearly on this subject, bonds must be eliminated entirely as sources of revenue and attention confined to the different sources of ordinary revenue. When this is done it will be found that the property tax is paying at least 60 per cent of the entire burden for the construction and maintenance of roads and bridges throughout the country. These facts are brought out neither as an argument against the issue of bonds nor to minimize in any way the importance of bond issues as a perfectly legitimate part of any rational system of highway finance.

Real estate is bearing a very large share of the burden of highway taxes, and farm lands are bearing a relatively larger share, for the reason that certain county and township highway tax levies are not applied to property in the municipalities. These facts constitute a very strong fiscal argument against a policy of imposing special assessments on abutting and adjacent farm lands for the permanent improvement of state trunk highway systems. If such special assessments are imposed, they should constitute but a relatively small part of the cost of the improvement.

Federal Aid.—The facts with reference to the property tax would also seem to point to the equity and wisdom of the policy of federal aid from a fiscal standpoint. Federal taxes are obtained from income, inheritances, and various business taxes, such as duties on imports and excises on certain luxuries. Federal-aid money does not, to any large extent, come from the owners of farm lands, who already are paying more than a fair share of the taxes for road and bridge purposes. Indeed, a more

[1] *Report of the State Tax Commission*, pp. 52–53, New York, 1923.

TABLE X.—STATE OF NORTH DAKOTA[1]
Distribution of 1923 Tax Levy—No Special Taxes Included

	Purpose									
	General gov't taxes		Road and bridge		Education		Interest and sinking		Total	
	Amount	Per cent of total	Amount	Per cent of total	Amount	Per cent of total	Amount	Per cent of total	Amount	Per cent of total
State.										
Soldiers bonus levy	$1,089,150.71	3.62								
Legislature	37,831.65	0.13								
Judiciary	78,689.83	0.26								
State departments	322,541 84	1.07								
Penal and charitable institutions	345,457.01	1.15								
State Capitol building and car line	33,940 40	0.11								
Militia and compensation bureau	22 266 63	0.07								
Societies and associations	20 537 18	0.07								
Bounties and indemnities	39 993 46	0.13								
State aid to fire departments	29,616 78	0.10								
Home building ass'n deficit tax fund	54,455.96	0.18								
Miscellaneous state purposes	45,830.34	0.15								
Total	$2,120,311 79									
Educational institutions					$ 968,274.08	3.22				
General educational purposes, including state aid					216,829.40	0.72				
					$ 1,185,103.48					
State bond sinking							$ 98,019.71	0.33		
Industrial bonds interest							609,924.07	2.03		
Total state levy							707,943.88		$ 4,013,359.15	13.36
County	$3 661,088.15	12.18	$2,124,044.88	7.07			$ 874,229.72	2.91	6,659,362.75	22.16
Township	1 097,472.36	3.65	1,350,481.50	4.49			9,067.29	0.03	2,457,021.15	8.17
City and village	1 947,401.24	6.48	140,785 38	0.47			461,682.80	1.54	2,549,869.42	8.49
School										
Local levies					$11,967,821.51	39.83	1,601,260.09	5.33		
County tuition					544,352.34	1.81				
School polls					255,689.50	0.85				
Total school taxes									$14,369,123.44	47.82
Totals	$8,826,273.54	29.373	$3,615,311.76	12.031	$13,952,966.83	46.434	$3,654,183.78	12.16	$30,048,735.91	100.00
Per capita tax	$13.64		$5.59		$21.57		$5.65		$46.45	
Average tax rate (mills)	8.10 mills		3.32 mills		12.81 mills		3.36 mills		27.59 mills	

[1] *Seventh Biennial Report North Dakota Tax Commissioners*, p. 90, 1924.

TABLE XI.—TOTAL EXPENDITURES FOR ALL RURAL HIGHWAY PURPOSES IN 1921[1]

Geographic divisions and states	Total	Construction, roads and bridges	Per cent of total	Maintenance, roads and bridges	Per cent of total	Administration and engineering	Per cent of total	Principal and interest payments, highway bonds	Per cent of total	Purchase and repair of machinery and equipment and general miscellaneous	Per cent of total
Totals all states	$1,036,587,772	$626,965,373	60.5	$248,953,169	24.0	$36,031,353	3.5	$89,280,946	8.6	$35,716,931	3.4
New England	45,361,397	24,160,353	53.1	17,424,748	38.5	1,279,685	2.8	1,563,680	3.5	932,931	2.1
Maine	8,701,911	6,582,554	75.6	1,308,342	15.1	[a]73,064	0.8	442,186	5.1	295,765	3.4
New Hampshire	3,699,421	1,248,618	33.8	2,291,486	62.0	[a]16,158	0.3	[b]85,500	2.3	57,659	1.6
Vermont	2,150,484	1,048,747	48.7	1,092,998	50.8	[a]8,739	0.5				
Massachusetts	19,535,631	9,062,104	46.4	8,318,549	42.6	817,458	4.2	901,294	4.6	436,226	2.2
Rhode Island	2,828,234	2,028,813	71.9	439,757	15.5	112,642	4.0	134,700	4.7	112,322	3.9
Connecticut	8,445,716	4,189,517	49.5	3,973,616	47.1	251,624	3.0	.....	.....	30,959	0.4
Middle Atlantic	160,470,634	92,665,541	57.8	40,421,671	25.2	6,586,008	4.1	13,641,129	8.5	7,156,285	4.4
New York	57,025,011	31,732,971	55.6	14,031,131	24.6	2,345,952	4.2	6,111,269	10.7	[c]2,803,688	4.9
New Jersey	28,096,070	15,973,807	56.8	8,657,498	30.8	951,063	3.4	1,761,120	6.3	752,582	2.7
Pennsylvania	75,349,553	44,958,763	59.6	17,733,042	23.6	3,288,993	4.4	5,768,740	7.6	3,600,015	4.8
East North Central	267,988,153	153,897,286	57.5	70,262,240	26.2	8,021,674	3.0	28,945,920	10.8	6,861,033	2.5
Ohio	76,579,987	42,955,743	56.0	19,780,152	25.9	2,213,498	2.9	10,802,307	14.1	828,287	1.1
Indiana	54,502,332	27,606,442	50.7	14,732,391	27.0	1,236,659	2.3	10,360,184	19.0	566,656	1.0
Illinois	39,619,448	21,850,575	55.2	12,392,158	31.3	1,515,864	3.8	1,979,717	5.0	1,881,134	4.7
Michigan	55,572,618	36,244,828	65.2	10,550,568	19.0	2,153,616	3.9	4,864,124	8.7	1,759,482	3.2
Wisconsin	41,713,768	25,239,698	60.5	12,806,971	30.7	902,037	2.1	939,588	2.3	1,825,474	4.4
West North Central	148,865,686	93,066,467	62.4	42,570,471	28.7	4,068,240	2.7	3,740,035	2.5	5,420,473	3.7
Minnesota	38,779,560	23,816,054	61.5	10,736,693	27.7	909,334	2.3	1,631,658	4.2	1,682,821	4.3
Iowa	39,324,553	26,084,193	66.3	10,442,776	26.5	1,132,859	2.9	[d]		[c]1,664,725	4.2
Missouri	16,127,659	8,588,306	53.3	5,461,213	33.8	759,311	4.7	886,770	5.5	432,059	2.7
North Dakota	7,247,231	4,328,985	59.6	2,577,366	35.6	264,213	3.7	.....	.....	76,667	1.1
South Dakota	14,188,967	7,889,272	55.6	4,959,012	34.9	[e]356,484	2.5	436,802	3.1	547,397	3.9
Nebraska	10,527,609	6,291,375	59.8	3,677,566	34.9	184,565	1.8	166,178	1.6	207,625	1.9
Kansas	22,670,107	16,068,282	70.9	4,715,845	20.8	461,474	2.0	615,327	2.7	809,179	3.6
South Atlantic	106,656,946	65,759,252	61.6	22,003,745	20.6	1,210,398	1.0	9,728,269	9.1	4,955,282	4.7
Delaware	6,035,637	4,561,318	75.6	535,610	8.9	240,976	4.0	165,588	7.7	232,115	3.8
Maryland	10,298,136	5,337,156	51.8	3,321,353	32.3	196,952	1.9	1,329,552	12.9	109,823	1.1
Virginia	15,485,392	8,254,186	53.4	5,015,909	32.5	931,949	6.1	1,101,970	7.1	151,078	0.9
West Virginia	10,060,073	7,271,371	72.3	1,126,626	11.2	193,987	1.9	[e]679,232	6.8	185,857	1.8
North Carolina	29,323,700	16,734,431	57.1	5,989,137	20.4	[b]782,257	2.7	3,705,965	12.6	2,111,610	7.2

South Carolina	10,049,281	7,280,309	72.6	1,259,289	12.5	504,021	5.0	[j]154,413	1.5	851,249	8 4
Georgia	15,816,594	10,029,427	63.5	2,853,167	18.0	779,485	4.9	1,245,083	7.9	909,432	5.7
Florida	9,588,133	6,287,424	65.6	1,569,354	16.4	280,771	2.9	1,046,466	10.9	404,118	4.2
East South Central	51,236,234	31,605,008	61 6	11,529,405	22.5	1,771,883	3.5	5,218,206	10.2	1,111,732	2.2
Kentucky	12,622,663	7,622,488	60.4	3,666,942	29.0	393,730	3.1	[j]789,585	6.3	149,918	1.2
Tennessee	12,697,447	8,160,059	64.3	2,715,290	21.4	723,784	5.7	[k]650,654	5.1	447,660	3.5
Alabama	5,607,835	2,935,461	52.3	1,488,065	26.5	210,476	3.8	726,134	13.0	247,699	4.4
Mississippi	20,308,289	12,887,000	63.3	3,659,108	18.1	443,893	2.2	3,051,833	15.1	266,455	1.3
West South Central	103,820,179	64,136,714	61.8	19,782,473	19.1	4,280,726	4.1	12,981,283	12.5	2,638,983	2.5
Arkansas	21,211,014	14,397,819	67.9	3,196,665	15.1	1,279,374	6.0	[l]1,857,208	8.8	479,948	2.2
Louisiana	14,022,003	10,479,570	74.8	875,883	6.2	[m]293,494	2.1	2,183,843	15.6	189,213	1.3
Oklahoma	14,679,891	9,068,249	61.8	3,576,748	24.3	837,330	5.7	748,413	5.1	449,151	3.1
Texas	53,907,271	30,191,076	56.1	12,133,177	22.5	1,870,528	3.5	8,191,819	15.1	1,520,671	2.8
Mountain	58,157,929	39,108,845	67.3	8,469,567	14.5	2,509,338	4.3	4,751,676	8.2	3,318,503	5.7
Montana	10,383,157	6,619,129	63 8	1,509,797	14.5	648,167	6.2	1,106,241	10.7	499,823	4.8
Idaho	11,807,383	8,263,361	70.0	1,467,630	12.4	226,705	1.9	1,020,946	8.7	828,741	7.0
Wyoming	4,725,412	3,197,397	67.7	612,970	13.0	234,908	5.0	396,200	8.3	283,937	6.0
Colorado	9,048 821	5,144,480	56.8	2,651,055	29.4	544,328	6.0	145,543	1.6	563,415	6.2
New Mexico	4 259 005	2,635,933	61.9	510,302	11 9	[n]111,667	2.6	889,541	21.0	111,562	2.6
Arizona	10,648,485	8,480,916	79.7	671,967	6.3	490,237	4.6	[o]443,673	4.2	561,692	5.2
Utah	5,174,714	3,462,964	66.9	787,730	15.2	137,418	2.7	610,475	11.8	176,127	3.4
Nevada	2 110 952	1,304,665	61.8	258,116	12.2	115,908	5.5	139,057	6.6	293,206	13.9
Pacific	94,030 614	62,565,907	66 5	16,128,849	17.2	3,303,401	3.5	8,710,748	9.3	3,321,709	3.5
Washington	24,238,729	17,344,669	71 5	3,384,970	14.0	732,835	3.0	2,009,679	8.3	766,576	3.2
Oregon	27,968,913	23,891,963	85.4	1,756,103	6.3	659,990	2.4	1,492,792	5.3	168,065	0.6
California	11 822,972	21,329 275	51 0	10,987,776	26.3	1,910,576	4.6	5,208,277	12.4	2,387,068	5.7

[a] General administration only. Cost of engineering charged to construction.
[b] Does not include approximately $15,000 of interest and principal on town bonds charged to construction.
[c] Includes interest and principal payments on county and town highway bonds.
[d] Interest and principal payments on road and bridge bonds and warrants amounting to approximately $1,000,000 for interest and $750,000 for principal were paid from county and township general funds. Data for bonds alone not available.
[e] Includes cost of gravel pits and railroad crossings.
[f] State administration and engineering. Local engineering and administration charged to construction and maintenance.
[g] Does not include approximately $270,000 of interest charged to construction.
[h] State engineering charged to construction and maintenance.
[i] Does not include approximately $450,000 interest and principal payments charged to "Miscellaneous."
[j] Does not include approximately $150,000 of interest payments charged to construction.
[k] Complete data not available. Total interest and principal payment on highway bonds estimated to have been approximately $2,000,000 during 1921.
[l] Complete data for principal and interest payments not available.
[m] Cost of State engineering and inspection charged to construction.
[n] State engineering amounting to approximately $140,000 charged to construction.
[o] Does not include approximately $400,000 of interest payments charged to construction.
[1] U. S. Dept. of Agriculture Bulletin 1279, pp. 13–14, 1921–1922.

liberal policy of federal aid would seem to be justified by these considerations.

State Aid.—Where the revenue system of a commonwealth includes forms of taxation other than the general property tax, a liberal policy of state aid for the construction and maintenance of the principal market roads will tend to lift part of the burden of taxation from the tiller of the soil.

Revenue obtained from motor-vehicle fees, gasoline taxes, and other special forms of taxation used for state aid, and a liberal policy of federal aid for highway purposes would seem to offer a solution of the great problem of securing equitable highway financing.

Conclusion.—It is a striking fact that of the $1,149,437,896 collected for all rural road purposes in 1921, perhaps not more than $40,000,000 were obtained from sources other than general property taxes and taxes on motor vehicles in one form or another. In addition the federal government in the years 1918 to 1924 inclusive, received $398,469,531.02 more from taxes on motor vehicles than was paid out in federal aid. If the federal government had paid out the entire sum received from motor vehicles in 1924, it would have afforded very substantial relief to the already overburdened owners of real estate. It is thus very apparent that more state aid, obtained as much as possible from sources other than the general property tax, and more federal aid point the way to a more equitable distribution of the vast and increasing burden for the construction and maintenance of the public highways of this nation.

Incidentally, these facts ought to furnish some very palatable food for thought on the part of those well-meaning but misguided politicians who are disposed to criticize both federal and state aid. A liberal policy of federal and state aid means a relative decrease, not an increase, in the burden on real estate in the form of taxes for the construction and maintenance of roads and bridges.

CHAPTER VII

FEDERAL AID

"A prophet is not without honor save in his own country." So runs the familiar adage. Sometimes, his own country is the best judge of the value of the prophecies of its officials. This is well illustrated in connection with a statement written by Mr. Dodge in 1901, which reads as follows:

> It is proper just here to call attention to a misconception which appears to exist in the minds of some to the effect that increased appropriations for this work (the educational work of the Office of Public Roads) may lead to national aid. It should be distinctly understood that the work of this office, like that of many other divisions of the department, is purely educational. In requesting an increased appropriation it was not the intention to shift the burden and responsibility of constructing improved roads from the states and counties to the general government. Such a plan is not feasible, and even if it were, it would not be desirable, for there could be no surer way of postponing the building of good roads than by making them dependent on national aid. Under such a system, states and counties would wait for national aid and little or nothing would be done.[1]

Act of 1912.—A little more than a decade later than this report by Mr. Dodge, Congress passed a law appropriating $500,000 to be expended by the Secretary of Agriculture in cooperation with the Postmaster General for improving roads over which rural mail service had been or might thereafter be established. At the same time a joint committee of five senators and five representatives was authorized to make inquiry into the subject of federal aid for the construction of post roads and report at the earliest practicable date. The Secretary of Agriculture, moreover, and the Postmaster General were directed to report to Congress, within 1 year after the ratification of the act, the results of their work thereunder. This law, which represented the real beginning of the modern policy of federal aid for highways in the United States, reads as follows:

[1] *Annual Reports of the U. S. Department of Agriculture*, p. 251, 1901.

That a joint committee shall be appointed, composed of five members of the Senate to be designated by the chairman of the Senate Committee on Post Offices and Post Roads, and five members of the House to be designated by the chairman of the House Committee on the Post Office and Post Roads, to make inquiry into the subject of federal aid in the construction of post roads and report at the earliest practicable date, and for this purpose they are authorized by subcommittee or otherwise to sit during the sessions or recess of Congress, at such times and places as they may deem advisable, to send for persons and papers, to administer oaths, to summon and compel the attendance of witnesses, and to employ such clerical, expert and stenographic assistance as shall be necessary, and to pay the necessary expenses of such inquiry there is hereby appropriated out of any money in the Treasury not otherwise appropriated the sum of twenty-five thousand dollars to be paid out upon the audit and order of the chairman or acting chairman of said committee:

Provided, That there is hereby appropriated the sum of five hundred thousand dollars, out of any money in the Treasury not otherwise appropriated, to be expended by the Secretary of Agriculture in cooperation with the Postmaster General in improving the conditions of roads to be selected by them over which rural delivery is or may hereafter be established, such improvement to be for the purpose of ascertaining the increase in the territory which could be served by each carrier as a result of such improvement, the possible increase in the number of delivery days in each year, the amount required in excess of local expenditures for the proper maintenance of such roads, and the relative saving to the government in the operation of the Rural Delivery Service, and to the local inhabitants in the transportation of their products by reason of such improvement and report the results in detail to Congress:

Provided, That the State or the local subdivision thereof in which such improvement is made under this provision shall furnish double the amount of money for the improvement of the road or roads so selected. Such improvement shall be made under the supervision of the Secretary of Agriculture.

That the Secretary of Agriculture and the Postmaster General are hereby directed to report to Congress within one year after the ratification of this Act the result of their operations under this act, the number of miles of road improved, the cost of same, and such other information as they may have acquired in connection with the operation of this act, together with such recommendations as shall seem wise for providing a general plan of national aid for the improvement of postal roads in cooperation with the states and counties, and to bring about as near as possible such cooperation among the various states as will insure uniform and equitable interstate highway regulations, and for providing necessary funds for carrying out such plans of national aid, if it shall be deemed

feasible to provide the same or any part thereof otherwise than by appropriation from the Treasury for that purpose.[1]

The above act was approved Aug. 21, 1912. Under a memorandum agreement between the Secretary of Agriculture and the Postmaster General, the Office of Public Roads through a Chief Inspector undertook to make a preliminary inspection of post roads designated for the improvement and also to make the necessary preliminary economic studies required to furnish the information called for by Congress, and to superintend construction of those projects approved by the Postmaster General.[2]

Secretary Houston's Recommendations.—In 1913, Mr. Houston, Secretary of Agriculture, spoke of the policy of federal aid in the following terms:

> With the growing interest in road construction and road maintenance, it becomes evident that the relation of the federal government to this work should be defined. It is believed that the federal government should take the lead in investigational and experimental work, having for its object the securing of facts necessary for the most economical methods of roadbuilding and road maintenance under the widely varying conditions existing in the United States. There is need for a central agency which can do the highest type of investigational work and can furnish the best information on all problems of road construction and road maintenance—an agency, in short, which shall be able to say the last word on matters pertaining to the construction and maintenance of roads and to road administration. The department has laboratories for testing and research work, issues numerous publications of an educational character, and employs a group of the best highway and engineer experts obtainable. It has actively aided the states and communities with suggestions or advice and has made demonstrations of its methods as opportunity has offered. The function of this department has heretofore been primarily educational, and as such it has been recognized to be of great value.
>
> Recently, Congress took a step of great importance and significance. Under conditions specified it made an appropriation of a half-million dollars, to be expended by the Secretary of Agriculture in cooperation with the Postmaster General in improving the condition of roads to be selected by them over which rural delivery is or may hereafter be established, and provided that such improvements should be made under the supervision of the Secretary of Agriculture. It made this appropriation

[1] "United States Statutes at Large," vol. 37, Part I, pp. 551–552, 1911–1913.

[2] *Annual Reports of the U. S. Department of Agriculture*, p. 289, 1913.

contingent on the appropriation of double the amount of money for such improvement by the state or the local subdivision thereof in which such improvement was to be made. As the regular appropriation for the Office of Public Roads is approximately $300,000, it will be seen that the Department of Agriculture has been charged with the supervision of an expenditure for roads of about one and three-quarter million dollars. The time has been too short to determine fully the value of the experiment authorized by Congress, and it has been recommended that it be continued with an increased appropriation.

The principle of cooperation with the states embodied in the action of Congress referred to is undoubtedly a helpful and wise one. It has heretofore characterized the relations of the department with the states in its educational or demonstrational work. It is believed that, if federal aid is to be further extended in the construction and maintenance of highways, any legislation to that end should incorporate this principle. It seems desirable that the federal government should deal with the state as the lowest unit through an expert highway commission as its agency. This policy would eliminate the difficulties of the federal government in determining local issues, as well as the danger of undue centralized government control. In order to stimulate self-help and to prevent undue inroads on the federal treasury, wherever federal aid is extended for construction and maintenance, it should be furnished on condition that the states provide an appropriation at least double that voted by the federal government. This would furnish an automatic check. The plans should probably provide for maintenance as well as construction, in order to prevent the possibility of the construction of roads many of which may wear out before the bonds placed upon them are paid. What roads should be improved is a matter of great moment. Unmistakably, roads of greatest economic and social importance are those over which the products from the farms can be taken to the nearest railway station and which minister to the other economic and social needs of the community. It would be desirable that no federal funds should be expended on any project until a scheme of road construction and maintenance within a state had been developed and previously agreed upon by the proper representatives of the state and of the federal government. That any money which may be appropriated by the federal government should be apportioned on the basis of a number of factors—such as total population, farm population, area, taxable valuation, and mileage—needs no detailed comment.[1]

Thus, as early as 1912 some very definite thinking had been done on the subject of federal aid for the construction and maintenance of roads and bridges. It seemed to be agreed that the

[1] *Annual Reports of the U. S. Department of Agriculture*, pp. 41–43, 1913.

government should take the lead in investigational and experimental work in the technical phases of highway construction and in the general field of road administration. There should be some final authority in technical matters of such outstanding economic importance. The provision of the law which stipulated that the states or the localities should expend two dollars for every dollar expended by the government, appeared to be wise. It was suggested that no federal money should be expended on any project until a comprehensive plan of road construction and maintenance within a given state had been worked out, preferably by an expert state highway commission, and approved by the federal government. The foundations of a policy with respect to federal aid were thus laid along the lines now familiar to the general public.

National Forest Roads.—The next step with reference to national aid was taken Mar. 4, 1913, in connection with the construction and maintenance of roads and trails within the national forests. Under the provisions of an act approved at that time making an appropriation for the United States Department of Agriculture, Congress stipulated:

> That hereafter an additional ten per centum of all moneys received from the national forests during each fiscal year shall be available at the end thereof, to be expended by the Secretary of Agriculture for the construction and maintenance of roads and trails within the national forests in the states from which such proceeds are derived; but the Secretary of Agriculture may, whenever practicable, in the construction and maintenance of such roads, secure the cooperation or aid of the proper State or Territorial authorities in the furtherance of any system of highways of which such roads may be made a part.[1]

At the close of the fiscal year, June 30, 1913, the amount of money available under this act was $210,925, and at the close of the next fiscal year, $239,182.[2]

In 1914 a division of the Office of Public Roads was created for the administration of roads in the national forests and in national parks. Road work in the national parks was prosecuted in cooperation with the Department of the Interior and in national forests in cooperation with the Forest Service of the Department of Agriculture. Lists of projects giving the order

[1] "United States Statutes at Large," vol. 37, Part I, p. 843, 1911–1913.

[2] *Annual Reports of the U. S. Department of Agriculture*, p. 275, 1914.

in which roads should be constructed in the national forests were prepared and forwarded to the Forester for his approval. Preliminary surveys were made in the national parks of the Yosemite and Sequoia in California, Glacier in Montana, Wind Cave in South Dakota, and Hot Springs in Arkansas. Three years before federal aid for highways was finally established as a definite national policy, a very substantial beginning had been made on post roads used for the delivery of rural mail, and in improving the roads and trails in the national forests and national parks.

Some progress was made in preliminary surveys and also in actual construction of roads and trails in the national forests and in the national parks, in the fiscal year ending 1915.

Report of Congressional Joint Committee.—The report of the Joint Committee on Federal Aid in the Construction of Post Roads was submitted by the Chairman, Senator Bourne, Nov. 25, 1914. This comprehensive report of 17 chapters and more than 300 pages, discusses almost every aspect of the road question, the emphasis being on the financial and administration phases of the problem. Aside from the half-dozen chapters devoted to general subjects including analyses of road bills and bibliography, special chapters deal with: Data from Foreign Countries; Data from the Several States; Data Regarding Rural Routes; The Old Cumberland Road; Instruction in Highway and Bridge Engineering; and statistical data on wealth, debt, highway expenditure, railway rates on road material and various possible methods of federal-aid apportionment.

At the very beginning of its report, the Committee points out the fact that the Cumberland Road, with its instructive history covering half a century, formed a precedent for federal aid and also put at rest any question of constitutionality when aid is granted under proper limitations and restrictions. The committee writes:

> Federal Aid to Good Roads, will accomplish several of the objects indicated by the framers of the Constitution—establish post roads, regulate commerce, provide for the common defense, and promote the general welfare. Above all, it will promote the general welfare.[1]

That favorable sentiment toward the good-roads movement had now become very general throughout the country is evi-

[1] Sixty-third Congress, Third Session, 1914–1915; *House Documents*, vol. 99; "Federal Aid to Good Roads," p. 14.

denced by the fact that forty-nine bills proposing federal aid in some form were introduced in the Sixty-third Congress; ten by the Senate, and thirty-nine by the House.[1]

FEDERAL-AID ACT OF 1916

While a small beginning was made under the provisions of the Acts of Congress outlined above, federal aid as a definite national policy may be said to date from July 11, 1916, when Congress made an appropriation of $5,000,000 for the fiscal year ending June 30, 1917; $10,000,000 for 1918; $15,000,000 for 1919; $20,000,000 for 1920, and $25,000,000 for 1921. With a total appropriation of $75,000,000 spread over a period of 5 years, it was now possible for the Bureau of Public Roads and the state highway departments to begin in earnest on a program for the improvement of the public highways.[2] Under the provisions of the Act of 1916, the Secretary of Agriculture is authorized to cooperate with the state highway departments, no money being expended in a state without the consent of its legislature except that the governor of a state may give his consent until the date of final adjournment of the first regular session of the legislature after the passage of the law. It is further provided that the Secretary of Agriculture and the highway department of each state shall agree upon the roads to be constructed and the plans and method of construction.

Apportionment.—After making a deduction not to exceed 3 per cent of the appropriation for any fiscal year for administering the provisions of the act, the Secretary of Agriculture is directed to apportion the balance among the several states as follows: one-third in the ratio which the area of each state bears to the total area of all the states; one-third in the ratio which the population of each state bears to the total population of all the states, as shown by the latest available federal census; and the remaining one-third in the ratio which the mileage of rural delivery routes and star routes in each state bears to the total mileage of delivery routes and star routes in all the states.[3]

Roads in National Forests.—In addition to the appropriation of $75,000,000 for federal aid to the states, Congress at the same time appropriated the sum of $1,000,000 for each fiscal year

[1] *Ibid.*, pp. 255–270.

[2] "United States Statutes at Large," vol. 39, Part I, p. 356.

[3] *Ibid.*, vol. 39, p. 357.

beginning July 1, 1916, for the survey, construction, and maintenance of roads and trails within or only partly within the national forests when such roads are necessary for the development of resources upon which communities within and adjacent to the national forests are dependent. It was made the duty of the state, territory, or county to enter into a cooperative agreement with the Secretary of Agriculture for the survey, construction, and maintenance of such roads or trails upon a basis equitable to all parties concerned.[1]

Progress.—By the end of 1916, thirty-two states had indicated their intention to assent to the provisions of federal aid, one through its legislature and the others through their governors. Nine states had definitely determined to submit a program of work covering the 5-year period for which federal appropriation had been made, and eight states had submitted specific projects for consideration.[2] During 1917 satisfactory progress was made in the administration of federal aid. So great was the expansion of work that the Office of Public Roads and Rural Engineering was divided into two branches; Management and Economics branch, and Engineering branch. Ten district officers with an engineer in charge of each were established in different parts of the country. Rules and regulations governing the administration of the law had been issued by the Secretary of Agriculture after a conference with state highway officials. These rules disregarded many of the suggestions made by the states and were never satisfactory. Later, they were revised to meet the objections that had arisen in the administration of federal aid.

One of the immediate and most important results of the new law was the stimulation of progressive road legislation by the several states. Haphazard methods of construction and maintenance of the public highways were now giving way to an orderly, systematic, and economical administration of this public utility. The states of Delaware, Georgia, South Carolina, Indiana, Texas, and Nevada had no state highway departments when the federal-aid law was passed in 1916; and in Florida, Arkansas, Oklahoma, Michigan, Missouri, Kansas, South Dakota, Idaho, and Wyoming additional legislation was required before their highway departments could perform the functions contemplated by the federal-aid law. By the close of the fiscal year 1917, every state

[1] *Ibid.*, p. 358.

[2] *Annual Reports of the U. S. Department of Agriculture*, pp. 37–38, 1916.

in the Union had a state highway department of the form prescribed in the Federal-aid Act, and every state had given its assent to the terms of the federal-aid law. Prior to 1916 thirty-three states had made provision for definite highway systems embracing the main-traveled roads, and by the close of the fiscal year 1917, seven additional states had authorized the establishment of definite state highway systems.

Similar progress had been achieved in the maintenance and construction work on the public highways. Up to 1916, thirty-three states had provided for state participation in road maintenance, but in 1917 this number had been increased to forty-two. Forty states had submitted a total of 183 federal-aid construction projects involving a total of approximately 1,730 miles. Of this number 139 projects, embracing 1,182 miles and calling for an estimated total expenditure of $7,947,114.50, had been approved.

Other Benefits.—The Federal-aid Act brought about a number of incidental benefits. Standardization of highway plans, specifications, methods of testing; more uniform standards of design for roads and bridges; the pooling of information with reference to construction methods; general improvement in organization methods, and a better correlation of different phases of highway work; all developed in the wake of federal aid and represent important mileposts in the good-roads movement.

Post-war Efforts.—Road improvement lagged during the time the United States was involved in the World War and the federal-aid construction fell off very materially. After the signing of the Armistice in 1918, arrangements were made for the resumption and vigorous prosecution of road work in all sections of the country, which incidentally furnished employment to large numbers of men during the period of transition from war to peace.

FEDERAL-AID AMENDMENTS OF 1919

Under the provisions of a law approved Feb. 28, 1919, the definition of the kinds of roads that might be constructed was greatly broadened and the limitation on the federal contribution for any one road was increased from $10,000 to $20,000 a mile.[1] There had been three limitations which prevented the law of 1916 from being fully effective: the post-road requirement; the limita-

[1] "United States Statutes at Large," vol. 40, Part I, p. 201.

tion of federal participation to $10,000 per mile; and inadequate appropriations for federal aid. Regarding the first two points the Secretary of Agriculture says:

The act, as amended, places only three limitations on the type of road which may be built, as follows:

1. That the roads shall be "substantial in character." This means that the road must be so constructed that it will carry the prospective traffic with such maintenance expenses that the total annual charges will represent a reasonable expenditure for the public service rendered by the highway. It is to the interest of the states that the roads on which federal funds are used be substantially constructed, because the law requires them or their civil subdivisions as a prerequisite to receiving further funds, to maintain properly all roads built with federal aid. There is nothing in the law which restricts types of construction between narrower limits than those established by sound finance and good engineering practice.

2. That the amount contributed from the federal treasury in connection with any road shall not exceed 50 per cent of its cost, or $20,000 a mile. The main thing is to build a road that will stand the traffic in the particular section of the country where it is constructed. The conditions in certain regions may require a heavy, comparatively high-cost type of road, while in others a lower-cost type may meet all the requirements. Sentiment is growing throughout the country, even in the newer sections, in favor of more substantial roads. The people are beginning to realize that the expense of maintaining the lighter-traffic types under heavy traffic is unbearable.

3. That the road must be a "rural post road" as defined in the act as amended; that is, "any public road a major portion of which is now used, or can be used, or forms a connecting link not to exceed 10 miles in length of any road or roads now or hereafter used for the transportation of the United States mails." Under the original working of the law, federal funds could be expended only on roads upon which the United States mails "now are or may hereafter be transported." This feature was the most troublesome to the highway departments of the various states. It required a definite determination in each case of the actual post-route status of the road, which necessarily involved delays in many instances. Under the new definition, very few important roads, if any, will be debarred from receiving federal aid, if all the other requirements of the act are met.

Following the amendments to the act, the regulations governing its administration and the standards for plans, specifications and estimates were modified, and one of the most successful former state highway engineers in the country was placed in charge of the federal-aid road work. He has at his disposal a large staff of local and district engineer

aids, and no pains will be spared to provide any further federal assistance that may be needed. An advisory committee, composed of representatives of the state highway departments, selected at the request of the department, by the American Association of State Highway Officials, with due regard to geographic consideration, also has been appointed to work in intimate touch with the federal bureau, meeting with its officers at stated periods and at such other times as may seem desirable.[1]

National Highway Commission.—The next hurdle provided for the good-roads movement was the suggestion that federal supervision of highways should be taken from the Department of Agriculture and placed under a new government agency to be called the Federal Highway Commission. A bill was introduced in the Senate providing for a commission of three members, each to receive an annual salary of $10,000, whose duty would be to establish, improve, repair, and maintain a system of highways comprising not less than 2 per cent nor more than 5 per cent of the total highway mileage actually used as such in a given state; and not less than 2 per cent nor more than 4 per cent of the total highway mileage actually used as such in the country at large. Under the terms of the bill the proposed Federal Highway Commission was given the power to select or establish the highways to be comprised in the system and also to determine the order of construction, repair, and maintenance. This highly centralized administrative machinery with duties duplicating in large measure the work done by state highway departments, was not considered favorably by Congress.[2]

New Administrative Regulations.—The rules and regulations for the administration of the Federal-aid Act originally issued by the Secretary of Agriculture Sept. 1, 1916, were found to be unworkable because of conflicts with state laws or state constitutions, restrictions against the expenditure of federal-aid funds for certain costs entering into completed roads, the nature of the plan, specifications and survey requirements, adherence to standard specifications when economy prompted modifications, and difficulties or delays encountered from inception of projects to final completion, due in many cases to overcentralization and lack of authority on the part of the district engineers or the local representatives of the Bureau of Public Roads. At a meeting with state highway officials in Dec., 1918, a general revision of the

[1] *Annual Reports of U. S. Department of Agriculture*, pp. 36–37. 1919.
[2] *Ibid.*, pp. 39–42.

rules and regulations was undertaken. These were finally completed and issued early in 1919, and have proved generally satisfactory to the state highway departments and the government.

Forest Road Projects.—In spite of the war, some progress was made in the forest road activities of the Bureau for the year ending June 30, 1919. Sixty-three engineering investigations and reconstruction surveys were completed, involving 1,354 miles of road to be improved at an estimated cost of $9,356,967. Location surveys were in progress on twenty-one additional projects, and plans were in preparation for thirty-four projects. Actual construction work is reported on thirty-nine projects, with a mileage of 581 and an estimated cost of $3,332,243. Only three projects, however, were completed, the cost being $155,316.[1]

Additional Appropriations.—Under the Act of Congress approved Feb. 28, 1919, making appropriation for the service of the Post Office Department and for other purposes, additional federal aid was appropriated as follows: $50,000,000 for the fiscal year ending June 31, 1919; $75,000,000 for 1920, and $75,000,000 for 1921.[2] Added to the appropriation previously made under the Act of 1916, there was a total appropriation of $65,000,000 for the fiscal year 1919; $95,000,000 for 1920; and $100,000,000 for 1921. In addition to these sums, $9,000,000 was appropriated for the years 1919 to 1921 inclusive for the survey, construction, and maintenance of roads and trails within or partly within the national forests.[3]

Road Location. The location and character of the roads, upon which federal aid was to be expended, now began to be of considerable importance. The Federal-aid Act as amended provides that federal money may be expended on any public road the major portion of which is now used or can be used, or forms a connecting link not to exceed 10 miles in length of any road or roads now or hereafter used for the transportation of the United States mail. Federal-aid roads should comply with this very general statutory requirement, but in addition should be of sufficient general importance to warrant the expenditure of federal-aid funds upon them. Increasing care began to be exercised to insure that each federal-aid project involved roads that really deserved to receive federal aid.

[1] *Ibid.*, pp. 410, 411.

[2] "United States Statutes at Large," vol. 40, Part I, pp. 1, 201.

[3] *Ibid.*, pp. 1201–1202.

Classification Proposed.—Emphasis is placed on the fact that federal money will not be expended entirely for so-called national roads, especially in some of the eastern states with long-established state highway departments, where roads of this character for the most part already have been well improved. The opinion is expressed that a large part of the money should be expended in improving the roads which radiate from market and shipping points into the surrounding agricultural country. In order to provide a more rational basis for coordinating work done by the various states, the Bureau of Public Roads, in conference with an Advisory Committee of the state highway officials initiated plans for a nation-wide survey of the roads of the country and a classification of all highways according to importance and the character of service rendered.

FEDERAL-AID AMENDMENTS OF 1921

Under the provisions of an act approved Nov. 9, 1921, amending the federal-aid law of 1916 and amendments thereto, an additional appropriation of $75,000,000 was made for the fiscal year ending June 30, 1922, of which $25,000,000 was immediately available and $50,000,000 was available Jan. 1, 1922.[1] For the survey, construction, reconstruction, and maintenance of forest roads and trails an additional appropriation of $5,000,000 was made for 1922, and $10,000,000 for 1923. Half of this additional appropriation, but not to exceed $3,000,000 was authorized for roads and trails of primary importance to the national forests, and the remaining half for roads of primary importance to adjacent communities.[2] Under the provisions of an act making appropriation for the Post Office Department for 1923 and for other purposes, additional appropriations for federal aid were made as follows: $50,000,000 for the fiscal year ending June 30, 1923; $65,000,000 for 1924; and $75,000,000 for 1925. At the same time additional appropriations were authorized for forest roads and trails as follows: $6,500,000 for the fiscal year 1924 and the same amount for 1925.[3]

New Provisions of Federal-aid Laws.—With the amendments made in 1921 the federal-aid law was greatly improved, thus making possible a more efficient plan of highway finance and administration. The more important changes should be noted.

[1] "United States Statutes at Large," vol. 42, Part I, pp. 216–217.

[2] *Ibid.*, p. 218.

[3] *Ibid.*, p. 660.

Before any projects are approved under the law as amended, a given state through its state highway department is required to select or designate a system of highways comprising not to exceed 7 per cent of the total highway mileage of said state. All federal-aid apportionments are made to roads in this system. In order, however, to insure a more equitable distribution of federal aid as between trunk-line, interstate highways, and necessary supplementary market roads, the law further stipulates that highways receiving federal aid shall be divided into two classes, one known as primary or interstate roads, the same not to exceed three-sevenths of the total mileage; the balance to be known as secondary or intercounty highways. It is further provided that not more than 60 per cent of all federal aid allotted to any state shall be expended upon the primary or interstate highways until provision has been made for the improvement of the entire system.[1]

A second amendment of importance relates to the amount of federal aid that may be apportioned for the improvement of a given road. At first this had been fixed at $10,000 per mile, but in 1919 it had been increased to $20,000. Provision was made in 1921 for increasing this allotment in proportion to the increased percentage of federal aid authorized at the same time. The Secretary of the Treasury was required to set aside a sum for federal aid not to exceed 50 per cent of the total estimated cost.

> . . . except that in the case of any state containing unappropriated public lands exceeding 5 per centum of the total area of all lands in the state, the share of the United States payable under this act on account of such project shall not exceed 50 per centum of the total estimated cost thereof plus a percentage of such estimated cost equal to one-half of the percentage which the area of the unappropriated public lands in such state bears to the total area of such state.[2]

In the average state, money was expended under the federal-aid law in the proportion of $43 from the federal government to $57 provided by the state.

Maintenance. — Under the Federal-aid Act of 1916, as amended in 1919, the federal government might withhold the allotment of federal aid in case a state failed to make proper provision for maintenance of highways already constructed. Under the

[1] *Ibid.*, p. 213.

[2] *Ibid.*, p. 214.

1921 law this authority is retained, but in addition the Secretary of Agriculture is required to perform the work necessary to restore a neglected federal-aid road to good condition and charge the cost against the state's apportionment of federal aid. Moreover, no additional requests for federal aid are to be approved until the delinquent state has reimbursed the federal government for the amount of money spent for such maintenance work. Thus, the maintenance of federal-aid highways is fairly assured.

Road Types.—The law of 1921 provides that only such durable types of surface and materials shall be adopted for the construction and reconstruction of any highway which is a part of the primary or interstate and secondary or intercounty system as will adequately meet the existing and probable future traffic needs. The Secretary of Agriculture, moreover,

> . . . shall approve the types and width of construction and reconstruction, and the character of improvement, repair, and maintenance in each case, consideration being given to the type and character which shall be best suited for each locality and to the probable character and extent of the future traffic.[1]

Research.—In addition to the large appropriation made at this time to aid the states in constructing public highways, 2.5 per cent of the total appropriation for federal aid may be used in administering the act and in conducting highway research. Some money has been expended for the latter purpose, but nowhere near the amount that the conditions would justify.

Status of Federal Aid, 1925.—The various appropriations for federal aid, including roads and trails in the national forests to the close of the fiscal year 1925, amount to nearly $600,000,000, as shown by the following tabulation:[2]

1917	$5,000,000	1922	$75,000,000
1918	10,000,000	1923	50,000,000
1919	65,000,000	1924	65,000,000
1920	95,000,000	1925	75,000,000
1921	100,000,000	Total	$540,000,000

The following amounts have been appropriated as federal aid for roads and trails in the national forests:[3]

[1] *Ibid.*, p. 214.
[2] *Ibid.*, p. 660.
[3] *Ibid.*, p. 660, for appropriations for 1924 and 1925.

1917	$1,000,000	1922	$6,000,000
1918	1,000,000	1923	11,000,000
1919	4,000,000	1924	7,500,000
1920	4,000,000	1925	7,500,000
1921	4,000,000	Total	$46,000,000

The 10 per cent fund for the aid of roads in the national forests, as already outlined, is in addition to these appropriations.

The amount expended out of these appropriations represents a relatively small part of the total expenditure for the construction and maintenance of the public highways. The total income for all rural road purposes in 1921 was $1,149,437,896.[1] Of this amount federal aid, including appropriations for forest roads, was $79,333,226, or only 6.9 per cent of the total. During that year the sum obtained from the sale of bonds was $438,109,273, or 38.1 per cent; the income from general property taxes $415,681,010, or 36.2 per cent. In fact, motor-vehicle fees and gasoline taxes contributed 10.6 per cent of the total road income, while federal aid amounted to but 6.9 per cent.

Federal-aid Benefits.—The benefits of the federal-aid policy are both direct and indirect. The direct expenditure of large sums of money on the principal highways of the nation will in the next few years help make possible the improvement of the public highways connecting cities of a population of 5,000 or over. This in itself is a great benefit. The indirect benefits, however, are perhaps even greater. For a number of years the policy of constructing object-lesson roads in the various states gave the people in those communities an illustration of the value of good roads. The construction and maintenance of 7 per cent of the public highways, according to the best standards of highway engineering and highway finance, will serve to impress on the state, but more especially on the county, township, and other political subdivisions, the wisdom of scientific methods of improving secondary roads with due regard for traffic needs. Slowly but surely, the expenditure of a billion dollars annually is being placed on a more efficient business basis; and very much of the credit is due to the labors of the Bureau of Public Roads in its efforts along educational lines and in the administration of federal aid, and to the very painstaking efforts of the better organized highway departments.

[1] See Table IX.

Classification of Completed Roads.—The establishment of a system of public highways, the mileage of which shall not exceed 7 per cent of the total highway mileage in any state, divided between interstate and intercounty highways, was in itself a measure of far-reaching importance. Regarding the magnitude of this classification of highways, Mr. MacDonald, Chief of the Bureau of Public Roads, states:

> The selection of 7 per cent of the roads of the nation for future systematic improvement is unquestionably the largest and most important task ever assigned to the bureau. Its successful accomplishment predicated an unusual knowledge of agricultural, industrial, and traffic development throughout the country and demanded as an indispensable condition the cooperation of the closest and most sympathetic kind with all of the states. The terms of the act are brief and general and the conditions actually existing in the United States vary within wide limits, so that it has required very careful study and adjustment to arrange for the designation and approval of the system of roads required by the law. Immediately on the passage of the act, this feature of the law was taken under careful consideration, and in December, 1921, the first instructions were issued providing for the submission by each of the states of tentative federal-aid systems within the state. In this way an initial expression of opinion and the result of the studies of the several state highway departments were secured.[1]

United States Highways. The map of the federal-aid system, published Nov. 1, 1923, presented a definite plan for the improvement of the main arterial highways of the nation in a period of not more than 10 years. These highways will permit unobstructed transportation between all cities of 5,000 population or larger. The duty of constructing and maintaining roads to connect with the main system is left with the states and their local subdivisions of government. The map of the "7 per cent system" as originally issued included 168,881 miles. Subsequent additions were made in several states which increased the total on June 30, 1924, to 171,687 miles.

In three states—Delaware, Maryland, and Rhode Island—the original system has been completed already or provided for and additions to the system in excess of the 7 per cent have been approved by the Secretary of Agriculture, as state funds become available for such extensions. Anticipating the completion of the system in other states which have a much larger mileage of

[1] *Annual Reports of the U. S. Department of Agriculture*, p. 462, 1922.

public roads, a detailed examination of the entire highways net in these states is being made. These maps of completed highway systems, together with descriptions of each improved section, will furnish the best collection of road data that has ever been undertaken.

System of Forest Roads.—The improvement of roads in the national forests should keep pace with the development of the highway system of the country as a whole. In addition to the local value which any road possesses, many of these forest roads form connecting links for some of the leading trunk-line highways of the nation. Recognizing these obvious considerations, three different classes of roads in the national forests were selected by conference between representative of the state highway departments, the Bureau of Public Roads, and the Forest Service. The first class includes all existing and proposed roads or parts of roads which are necessary sections or extensions of the federal-aid system wholly within the national forests. The second class includes other existing and proposed roads or parts of roads which are extensions of the federal-aid system and partly within, or adjacent to and serving, the national forests, and which may be designated as forest roads by the Forester and the Chief of the Bureau of Public Roads. The last class embraces existing or proposed forest roads of primary importance to counties or smaller communities.

It is estimated by the Chief of the Bureau of Public Roads that the forest highway system when completed will include approximately 775 miles of the first class, between 6,000 and 7,000 miles of the second class, and between 4,000 and 5,000 miles of the third class, or approximately 12,000 miles of forest highways. The law requires all future highway appropriations to be expended on the system of forest roads that is finally approved.

At the close of the fiscal year 1924, 1,823 miles of forest roads had been completed, representing an expenditure of $18,228,-301.52. This amount does not include the cost of administration, surveys, and plans, but does include an allowance for government-owned material and equipment used in construction. On the same date there were under construction 1,042.5 miles of forest roads estimated to cost in excess of $16,000,000.

Statistical Data. Table XII shows the mileage, total cost, and federal aid allotted to all federal-aid roads completed up to June 30, 1924, by states. It will be observed that 35,156.9

miles had been completed at a total cost of $602,326,389.21, of which federal aid represented $261,955, 709.90.[1]

Table XIII gives the mileage, total cost, and federal aid allotted to federal-aid roads completed during the fiscal year 1924, said data being arranged by states. It will be noted that 8,620.3 miles were completed at a total cost of $144,707,337.26 of which federal aid represented $66,789,426.70.[2]

Table XIV gives the mileage of all federal-aid roads completed up to June 30, 1924, by types of construction and also by states. This table is significant from various points of view. It is apparent, for example, that all federal money is not being expended on so-called hard-surfaced roads.[3]

Table XV is a summary of the accomplishments under the federal-aid Act of 1916 and amendments thereto.[4]

[1] *Ibid.*, p. 3.
[2] *Ibid.*, p. 4.
[3] *Ibid.*, p. 5.
[4] "Public Roads," vol. 7, 4, June, 1926.

TABLE XII.—MILEAGE, TOTAL COST, AND FEDERAL AID ALLOTTED TO ALL FEDERAL-AID ROADS COMPLETED UP TO JUNE 30, 1924, BY STATES

State	Total cost[1]	Federal aid[1]	Miles
Alabama	$ 7,517,652.60	$ 3,645,712.99	671.5
Arizona	8,464,741.67	4,364,912.41	537.7
Arkansas	11,168,854.55	4,459,345.63	948.9
California	17,129,807.90	7,860,406.87	681.4
Colorado	9,624,118.34	4,875,189.66	578.3
Connecticut	3,411,625.09	1,433,498.60	81.8
Delaware	3,479,251.47	1,188,737.33	84.3
Florida	2,959,921.69	1,432,297.39	112.6
Georgia	18,255,751.55	8,485,801.41	1,326.8
Idaho	8,412,287.56	4,233,045.90	526.8
Illinois	30,529,027.07	14,059,816.59	914.2
Indiana	8,851,308.28	4,288,205.02	263.2
Iowa	23,392,465.64	9,323,231.86	1,688.6
Kansas	22,157,546.12	7,727,772.68	657.5
Kentucky	11,240,234.38	4,826,886.37	452.9
Louisiana	8,834,764.36	3,801,223.09	701.1
Maine	7,028,584.03	3,358,698.00	237.0
Maryland	7,001,602.09	3,332,677.06	252.7
Massachusetts	11,218,868.20	4,490,689.22	254.4
Michigan	15,651,440.84	7,167,293.78	573.9
Minnesota	23,990,791.09	9,889,836.27	2,310.2
Mississippi	7,888,193.89	3,828,845.32	655.0
Missouri	12,712,501.43	5,926,010.43	906.1
Montana	8,911,059.55	4,408,281.04	805.7
Nebraska	10,310,188.74	4,909,514.60	1,718.9
Nevada	3,946,723.21	2,324,136.18	282.5
New Hampshire	3,228,323.59	1,554,076.35	176.2
New Jersey	8,266,033.22	2,872,160.02	159.2
New Mexico	6,708,414.96	3,602,488.73	879.6
New York	21,514,710.61	9,286,615.78	627.6
North Carolina	16,828,430.45	7,245,122.17	1,005.1
North Dakota	9,177,593.39	4,464,647.10	1,634.2
Ohio	33,856,447.68	12,110,970.93	984.8
Oklahoma	12,986,865.26	5,888,852.03	497.3
Oregon	12,378,149.70	5,999,884.29	676.2
Pennsylvania	42,432,577.89	16,096,142.29	831.0
Rhode Island	1,952,560.40	841,827.96	49.1
South Carolina	9,278,992.55	4,315,610.91	1,035.6
South Dakota	9,471,954.54	4,703,417.22	1,096.6
Tennessee	7,578,569.06	3,700,378.92	292.1
Texas	42,511,071.15	16,242,423.41	3,161.5
Utah	4,181,049.06	2,403,576.97	317.5
Vermont	1,922,114.16	942,769.12	74.4
Virginia	11,295,753.95	5,390,201.02	620.8
Washington	11,192,478.17	5,231,713.29	469.2
West Virginia	6,171,851.10	2,663,341.02	275.8
Wisconsin	19,078,289.18	7,605,283.33	1,356.8
Wyoming	6,224,847.80	3,152,141.34	712.3
Total	$602,326,389.21	$261,955,709.90	35,156.9

[1] Figures subject to revison on payment of a few final vouchers now outstanding.

TABLE XIII.—MILEAGE, TOTAL COST, AND FEDERAL AID ALLOTTED TO FEDERAL-AID ROADS COMPLETED DURING THE FISCAL YEAR 1924, BY STATES

State	Total cost[1]	Federal aid[1]	Miles
Alabama	$ 3,498,331.31	$ 1,735,855.02	281.6
Arizona	1,867,550.18	1,120,842.26	161.1
Arkansas	1,710,491.98	754,273.51	120.7
California	5,966,694.48	2,961,544.12	236.1
Colorado	2,426,060.84	1,340,102.69	119.9
Connecticut	637,077.64	329,349.75	17.2
Delaware	882,552.75	404,957.50	26.6
Florida	1,835,869.96	889,031.97	54.1
Georgia	3,385,611.08	1,670,211.85	313.4
Idaho	1,531,613.83	960,934.89	100.7
Illinois	5,283,778.96	2,628,663.69	169.4
Indiana	2,429,554.75	1,170,062.58	83.6
Iowa	6,708,418.12	2,976,930.45	498.3
Kansas	2,814,977.98	2,221,652.64	197.0
Kentucky	4,091,665.45	1,772,755.66	149.8
Louisiana	774,581.92	354,427.71	51.2
Maine	1,901,381.81	891,784.33	77.0
Maryland	1,486,580.88	709,254.92	60.6
Massachusetts	3,290,325.72	1,221,644.39	64.5
Michigan	4,327,152.21	1,957,761.76	151.5
Minnesota	3,614,442.16	1,612,349.17	379.6
Mississippi	2,119,022.64	1,043,974.35	144.3
Missouri	4,036,079.66	2,002,794.21	357.0
Montana	678,175.29	357,753.90	63.9
Nebraska	2,578,227.83	1,186,018.65	337.8
Nevada	490,595.18	474,163.13	51.7
New Hampshire	804,712.87	391,342.72	34.5
New Jersey	2,257,014.09	709,736.50	37.8
New Mexico	1,449,383.46	861,822.67	179.0
New York	9,357,341.72	4,038,673.77	291.0
North Carolina	3,914,317.99	1,479,048.51	110.2
North Dakota	3,201,497.94	1,562,676.03	668.2
Ohio	8,972,108.94	3,473,067.42	267.7
Oklahoma	2,610,121.38	1,178,008.92	123.8
Oregon	1,830,105.86	1,121,358.05	132.4
Pennsylvania	9,165,681.09	3,396,083.50	174.0
Rhode Island	468,485.05	194,193.00	10.5
South Carolina	2,799,080.27	1,280,643.13	320.6
South Dakota	3,399,339.49	1,726,556.03	417.4
Tennessee	2,101,606.26	1,031,620.82	85.2
Texas	9,488,741.88	3,558,051.67	641.2
Utah	1,482,812.55	869,250.45	139.9
Vermont	551,398.53	273,335.37	21.3
Virginia	3,234,876.38	1,496,941.16	163.9
Washington	835,497.35	412,607.59	49.4
West Virginia	1,636,124.52	651,078.19	52.0
Wisconsin	3,492,543.18	1,569,794.09	265.8
Wyoming	1,287,731.85	764,442.01	165.9
Total	$144,707,337.26	$66,789,426.70	8,620.3

[1] Figures subject to revision on payment of a few final vouchers now outstanding.

TABLE XIV.—MILEAGE OF ALL FEDERAL-AID ROADS COMPLETED UP TO JUNE 30, 1924, BY TYPES OF CONSTRUCTION AND BY STATES

States	Graded and drained	Sand-clay	Gravel	Water-bound macadam	Bituminous macadam	Bituminous concrete	Portland cement concrete	Brick	Bridges	Total
Alabama	3.2	286.7	277.7	11.6	26.6	54.8	9.6	.....	1.3	671.5
Arizona	52.7	55.9	312.6	14.2	.....	9.0	92.3	.....	1.2	537.7
Arkansas			660.0	44.8	29.5	176.4	37.2	.....	1.1	948.9
California	218.8	.....	102.7	7.3	45.6	26.5	279.6	.....	1.0	681.4
Colorado	150.5	67.4	240.8	.....	.....	1.0	116.3	.....	2.2	578.3
Connecticut	.....	.....	.....	.....	27.1	.....	54.7	.....	.	81.8
Delaware			.	.....	.....	.....	78.1	6.2	.	84.3
Florida	.....	21.2	.....	.....	42.1	8.6	30.6	10.1	0.1	112.6
Georgia	58.3	836.9	209.9	22.2	69.8	11.6	103.4	0.3	14.6	1,326.8
Idaho	111.4	18.6	337.5	4.3	.....	33.0	21.3	.....	0.9	526.8
Illinois	135.1	.....	0.4	.....	3.3	8.1	748.7	17.3	1.2	914.2
Indiana	0.5		12.4			12.0	238.0	.....	0.4	263.2
Iowa	1,014.4	....	311.4				307.9	22.0	..	1,688.6
Kansas	97.1	16.8	109.8	4.5	28.5	.....	305.1	95.6	.	657.5
Kentucky	244.6	.....	41.8	38.4	82.0	.....	42.0	3.9	0.2	452.9
Louisiana	7.4	.....	683.0	3.2	.....	7.6	.. ....	.....	...	701.1
Maine	.....	.....	101.4	.....	96.1	.....	39.3	.....	0.2	237.0
Maryland	3.8	.....	28.9	0.1	27.3	12.3	180.4	.....		252.7
Massachusetts				3.3	111.0	25.0	81.6	.	0.5	254.4
Michigan			224.8	18.9	. .	61.5	268.3	.	.	573.9
Minnesota	221.0	.....	1,855.9	.....	.....	22.1	210.8	.....	0.3	2,310.2
Mississippi	121.4	11.4	113.5	11.1	.	3.4	52.0	9.2		655.0
Missouri	202.1		518.9	8.2	38.9	2.8	127.9	5.7	1.5	906.1
Montana	193.2	.....	555.9	16.0	6.9	0.9	31.3	.....	1.6	805.7
Nebraska	1,320.8	163.1	181.5	.....	.....	6.7	34.7	11.9	....	1,718.9
Nevada	69.9	7.0	153.3	.....	15.6	1.6	34.6	.. ..	0.5	282.5

New Hampshire	.	....	86.6	23.1	35.9	27.7	1.9	.....	1.0	176.2
New Jersey	.....	....	3.4		.....	5.0	150.8	.....	...	159.2
New Mexico	191.6	5.1	638.3	.	.....	0.7	43.2	.....	0.8	879.6
New York	.....	.....	.....	..	217.5	. .....	407.9	0.7	1.5	627.6
North Carolina	66.3	598.0	85.8	17.8	33.0	93.4	109.4	.....	1.4	1,005.1
North Dakota	1,322.2	6.5	300.3	.....	.....	0.7	3.0	.....	1.4	1,634.2
Ohio	25.0	.....	.....	82.6	204.8	84.7	292.1	295.6	0.1	984.8
Oklahoma	28.3	2.3	279.6	6.3	0.6	45.0	128.9	1.2	5.2	497.3
Oregon	96.6	.....	433.6	25.6	.....	52.9	66.8	.....	0.7	676.2
Pennsylvania	.....	.....	.....	.....	7.8	99.7	698.7	24.8	....	831.0
Rhode Island	.....	.....	.....	.....	10.5	31.5	7.1	.....	....	49.1
South Carolina	.....	875.2	94.0	.....	3.0	22.1	38.6	0.2	2.4	1,035.6
South Dakota	195.6	.....	899.4	.....	.....	. .....	0.8	.....	0.7	1,096.6
Tennessee	3.3	.....	61.3	50.6	147.1	7.4	21.9	.....	0.5	292.1
Texas	168.8	58.1	2,190.3	362.1	111.2	49.8	196.1	20.8	4.1	3,161.5
Utah	114.9	.....	132.1	9.3	.....	7.8	53.0	.....	0.5	317.5
Vermont	.....	.....	51.3	1.4	17.9	.....	3.5	.....	0.3	74.4
Virginia	18.0	179.0	71.1	108.5	106.0	3.3	134.3	.....	0.7	620.8
Washington	28.1	.....	262.3	.....	.....	. .....	177.4	.....	1.4	469.2
West Virginia	106.1	1.7	18.2	4.9	67.1	11.4	54.7	11.4	0.2	275.8
Wisconsin	233.6	140.5	673.8	2.7	9.6	.....	296.5	.....	0.1	1,356.8
Wyoming	190.6	373.1	132.5	.....	.....	1.2	12.9	.....	2.0	712.3
Total	7,015.1	3,727.5	13,810.9	903.0	1,652.3	1,029.2	6,428.2	536.9	53.8	35,156.9

TABLE XV.—STATUS OF FEDERAL-AID HIGHWAY CONSTRUCTION AS OF MAY 31, 1926

States	Fiscal years 1917–1925			Fiscal year 1926		
	Projects completed prior to July 1, 1925			Projects completed since June 30, 1925		
	Total cost	Federal aid	Miles	Total cost	Federal aid	Miles
Alabama	$ 5,970,097.71	$ 2,863,197.86	611.8	$ 11,644,803.06	$ 5,596,523.62	655.6
Arizona	9,580,133.43	5,016,119.94	613.8	1,230,100.53	748,233.76	102.3
Arkansas	13,310,190.08	5,380,181.73	1,048.9	4,643,529.91	2,081,104.37	261.5
California	22,346,175.99	10,719,249.61	894.8	4,513,257.39	2,114,444.58	150.9
Colorado	11,876,703.94	6,067,814 34	651 2	1,278,321 21	665,157 96	61.8
Connecticut	4 558,639.29	1,819,368 66	101 6	855,927 90	281,217.14	15 5
Delaware	4,281,559.81	1,496,190.65	107.1	636,492.48	285,474.95	17.2
Florida	2,959,273.72	1,405,487.97	96.3	723,609.59	344,533.96	36.5
Georgia	20,156,002.57	9,406,366 46	1,478 3	4,576,128 77	2,232,012 73	302 6
Idaho	9,394,676.80	4,815,332.26	600.1	1,525,282.72	954,548.38	115.8
Illinois	40,010,481.10	18,640,076.28	1,236.2	4,065,949.17	1,961,514.46	140.3
Indiana	13,639,172.65	6,562,455.68	422.1	3,023,955.71	1,467,991.44	102.6
Iowa	27,272,285.21	11,107,492.99	1,996.9	1,640,794.87	755,809.11	113.9
Kansas	20 399 695 77	9,755,273 32	831 4	6,426,905 87	2,835,215 93	329.1
Kentucky	14 832 324 28	6,205,994 59	584 9	4,667,594 35	1,756,029 10	123.7
Louisiana	11,939,424.97	5,279,870.86	927.6	1,891,167.71	867,535.71	128.3
Maine	8,174,281.31	3,907,870.33	281.4	573,271.45	284,637.06	22.2
Maryland	8,132,506.90	3,849,383.15	294.4	2,792,436.20	1,263,608.07	128.9
Massachusetts	14,047,656.22	5,467,661.28	300.6	3,985,743.02	1,110,609.34	68.6
Michigan	16,234,000.80	7,328,316.91	612.6	9,763,239.98	4,498,735.39	350.4
Minnesota	30 415 685 89	12,738,642 04	2,721 2	5,271,152 99	2,284,974 52	397.0
Mississippi	10,292,285.79	4,988,702.73	803.4	3,910,793.14	1,954,397.32	278.9
Missouri	17,368,156 57	8,219,411 43	1,118 9	10,661,050 09	5,094,711 47	395.9
Montana	10,156,600 41	5,317,523 15	921 6	1,244,383 40	1,015,942 74	133 3
Nebraska	9,306 374 36	4,389,523 50	1,570 6	2,169,810 65	1,056,279 01	195.0
Nevada	1,917,465 69	3,088,299 78	357 3	2,640,729 82	2,042,634 81	181 5

New Hampshire	4,165,687.86	1,986,226.87	208.1	826,870.74	391,223.20	29.5
New Jersey	11,961,357.45	3,820,679.99	219.1	4,227,678.25	1,236,143.72	68.5
New Mexico	8,717,999.18	4,914,070.61	1,081.3	3,568,872.54	2,326,079.86	329.6
New York	28,597,769.67	12,229,076.53	831.5	12,579,727.57	4,913,674.20	314.7
North Carolina	21,014,450.41	8,746,454.59	1,119.8	5,994,969.06	2,430,883.35	138.1
North Dakota	10,829,263.82	5,268,930.47	1,917.5	1,455,792.12	748,801.58	275.6
Ohio	41,572,252.81	15,244,993.93	1,191.1	6,059,391.44	2,107,214.63	171.8
Oklahoma	20,787,024.94	9,672,890.34	852.2	6,496,136.84	3,025,537.08	278.7
Oregon	14,388,188.70	7,142,364.63	794.6	2,325,783.62	1,256,645.21	111.3
Pennsylvania	43,054,835.19	16,222,023 97	850.3	17,824,416.03	5,169,421.37	325.5
Rhode Island	2,628,496.20	1,119,688 09	64.8	1,360,119.89	439,140.97	21.9
South Carolina	11,163,347.84	5,121,267 54	1,235.9	3,560,390.58	1,524,936.87	202.3
South Dakota	12,091,434.67	5,989,879.00	1,447.9	4,801,631.44	2,329,698.81	657.5
Tennessee	13,789,140.98	6,732,079.77	497.9	7,584,709.49	3,419,113.70	265.4
Texas	54,120,970.83	21,057,940.12	3,907.1	14,578,815.45	6,146,595.22	942.7
Utah	6,259,159.41	3,818,836.91	423.1	1,543,632.88	979,511.08	90.0
Vermont	3,015,174.51	1,452,894.45	107.8	1,226,868.13	564,805.06	26.7
Virginia	13,099,720.01	6,271,998 20	676.2	8,729,465.99	4,033,198.19	323.3
Washington	13,352,504.18	6,117,211.87	526.7	3,699,085.54	1,654,697.59	141.3
West Virginia	7,343,200.86	3,230,293.33	326.7	1,639,091.90	673,572.94	57.0
Wisconsin	21,807,140.91	8,910 640 62	1,451.7	2,994,612.24	1,446,735.85	137.4
Wyoming	8,809,819.33	4,739,096.67	982.0	2,087,000.03	1,282,218.38	151.5
Hawaii						
Totals	$740,140,790.82	$325,654,346.00	41,898.3	$211,521,493.75	$93,653,725.79	9,869.6

* Includes projects reported completed (final vouchers not yet paid) totaling: Estimated cost $77,031,615.32. Federal aid $33,660,927.65. Miles 3,018.2.

TABLE XV.—STATUS OF FEDERAL-AID HIGHWAY CONSTRUCTION AS OF MAY 31, 1926.—(*Continued*)

States	Fiscal year 1926						Balance of Federal aid fund available for new projects
	*Projects under construction			Projects approved for construction			
	Estimated cost	Federal aid allotted	Miles	Estimated cost	Federal aid allotted	Miles	
Alabama	$ 5,409,336.08	$ 2,579,949.31	231.1				$ 3,309,784.21
Arizona	1,537,643.65	1,043,510.75	95.0	$ 82,189.48	$ 50,225.99	12.2	2,759,158.56
Arkansas	4,940,580.79	2,370,447.28	306.8	536,670.32	236,160.00	37.4	1,537,910.62
California	11,170,314.24	5,518,926.90	312.8	604,506.02	245,734.28	7.6	3,474,459.63
Colorado	4,929,735.32	2,463,212.49	245.5	423,072.26	188,359.34	13.1	2,941,267.87
Connecticut	2,359,159.77	718,923.03	34.6	1,592,001.75	371,404.12	21.6	1,142,768.05
Delaware	1,115,536.81	470,577.90	28.2	496,458.35	204,710.90	12.2	17,103.60
Florida	9,725,858.00	4,613,485.95	272.7				1,721,446.12
Georgia	11,833,250.23	5,836,816.37	664.7	1,781,810.07	850,105.71	31.7	106,651.73
Idaho	2,622,706.72	1,643,810.45	132.2	1,134,789.56	648,430.81	77.2	497,505.10
Illinois	5,311,686.37	2,552,427.37	177.3				6,678,179.89
Indiana	16,255,226.39	7,587,045.09	437.7	448,910.56	222,014.00	10.7	2,364,848.79
Iowa	8,655,167.73	4,218,730.07	567.7	2,979,460.29	1,116,228.69	198.6	1,987,302.14
Kansas	11,014,045.22	4,371,309.59	602.3	1,688,438.64	557,846.70	113.6	1,944,765.46
Kentucky	6,516,469.46	3,063,970.19	320.6	299,364.07	149,682.03	4.6	2,037,133.09
Louisiana	3,311,151.85	1,605,168.11	149.4				1,519,833.32
Maine	1,809,495.54	706,814.24	57.5	1,526,777.08	525,167.78	39.3	1,040,038.59
Maryland	169,995.00	84,997.50	10.8	1,561,681.01	716,133.95	74.7	10,934.33
Massachusetts	3,550,349.48	963,029.43	16.1	493,149.82	110,235.00	7.6	2,427,190.95
Michigan	9,263,608.64	4,182,702.41	217.7	105,818.00	47,736.00	3.1	4,284,874.29
Minnesota	9,821,971.75	2,975,500.00	629.6	464,657.41	34,000.00	15.0	1,558,663.44
Mississippi	7,120,916.68	3,529,463.68	368.2	2,168,639.90	992,466.87	111.6	662,987.40
Missouri	20,377,381.96	8,051,229.54	557.3	2,256,076.18	949,782.63	57.8	468,300.93
Montana	1,523,431.87	1,008,165.06	120.4	836,221.14	456,127.69	97.7	5,627,126.36
Nebraska	12,109,329.60	5,998,239.67	1,215.4	1,511,163.70	769,987.15	164.0	2,421,205.37
Nevada	3,136,209.75	2,698,004.08	328.5				966,276.33

New Hampshire	582,611.55	274,125.52	17.7	241,941.63	117,707.65	8.2	400,208.76
New Jersey	6,746,521.08	2,515,017.44	31.3	240,608.13	45,765.00	3.1	849,813.85
New Mexico	1,456,200.02	966,613.62	116.3	112,357.05	70,735.50	5.6	2,694,886.41
New York	32,079,571.58	9,123,202.24	577.7	7,890,953.00	1,765,990.00	114.3	6,013,252.03
North Carolina	7,387,341.40	3,160,668.31	165.9	1,283,847.15	641,923.57	50.4	737,276.18
North Dakota	4,382,686.58	2,236,028.14	570.9	3,840,966.05	1,876,966.95	493.3	617,931.86
Ohio	9,432,894.33	3,653,206.34	293.8	3,927,570.42	1,381,899.48	103.2	3,344,481.62
Oklahoma	3,949,958.99	1,877,399.11	140.8	482,026.22	235,088.31	52.3	1,248,872.16
Oregon	3,462,508.87	1,913,780.24	159.5	519,886.14	303,949.91	22.2	262,607.01
Pennsylvania	25,155,981.30	7,060,697.63	512.9	3,107,544.09	1,032,120.89	67.5	1,854,517.14
Rhode Island	1,531,802.80	427,155.00	28.5	45,705.55	13,050.00	0.9	668,534.94
South Carolina	6,288,755.22	2,806,298.87	272.3	339,304.66	143,936.58	23.5	205,084.14
South Dakota	3,582,932.31	1,722,393.53	570.4	482,685.86	262,655.48	104.2	862,163.18
Tennessee	7,900,200.62	3,625,744.50	265.1	616,648.03	259,926.86	.....	1,243,726.17
Texas	18,773,855.28	8,311,683.32	961.1	3,243,754.71	1,459,817.79	86.0	3,630,394.55
Utah	2,149,723.47	1,573,821.69	187.5	385,929.62	297,447.91	27.4	1,149,161.41
Vermont	1,384,349.78	526,371.94	29.2	401,743.24	171,376.19	5.2	553,059.36
Virginia	6,673,203.06	2,925,727.08	193.1	458,694.60	217,711.77	14.0	52,878.76
Washington	3,233,193.60	1,615,600.00	32.1	345,788.76	129,000.00	16.4	629,266.54
West Virginia	5,659,295.82	2,250,710.76	143.6	1,049,669.28	450,047.64	39.6	747,886.33
Wisconsin	5,633,325.43	2,774,909.19	251.5	1,734,700.38	838,574.00	94.5	3,458,955.34
Wyoming	2,553,262.00	1,610,353.02	193.7	149,528.34	95,995.00	20.5	838,610.93
Hawaii	1,050,897.93	312,635.18	15.9	.....	.....	.....	787,517.82
Totals	$336,701,611.92	$144,123,599.13	13,860.9	$53,924,308.52	$21,584,526.42	2,463.6	$86,358,802.66

* Includes projects reported completed (final vouchers not yet paid) totaling: Estimated cost $77,031,615.32. Federal aid $33,660,927.65. Miles 3,018.2.

CHAPTER VIII

HIGHWAY BONDS

THE NATURE OF PUBLIC DEBTS

In the chapter on the first principles of highway finance, reference was made to the views of the late Prof. H. C. Adams regarding the nature of revenues laid to meet public debts as contrasted with ordinary forms of public revenue. By ordinary revenue is meant revenue from the public domain, public industries, fees, special assessments, certain miscellaneous sources, and taxes which may be levied on property, income, business, the transfer of property at death, or in anticipation of death, and on persons. Bonds represent anticipation of extraordinary revenue which, under normal conditions, must be secured during a period of years by increasing the rates of ordinary revenue. Adams states that public borrowing is justified under three conditions: first, to cover casual deficits; second, to meet fiscal emergencies such as war; and third, to procure funds for public investments.[1] By public investments he has in mind such enterprises as the construction of railways, highways, and levees, or the dredging of rivers. In such cases he holds that the improvements should be prosecuted as rapidly as possible and without interruption, and that therefore annual appropriations for these purposes are considered uneconomic, both by the engineer and the financier.

Bastable. — At about the same time that Adams wrote, one of the British writers on public finance, after giving a fairly complete historical analysis of the policy of public borrowing, presented the following general conclusion:

> On the whole, then, the rules applicable to the treatment of abnormal outlay for other than economic purposes may be stated as follows: (1) Expenditure should, so far as is possible, be met out of the annual receipts, and therefore increased outlay should be balanced by heavier taxation. (2) In the case of non-recurrent expense of large amount, a loan is preferable to a serious disturbance of the normal tax system,

[1] Adams, "The Science of Finance," pp. 526–533.

and may fairly be employed. (3) Where the abnormal expenditure extends over a series of years, the various forms of taxation should, speaking generally, be adjusted to meet it. (4) This general principle, however, fails where either (*a*) it would be impossible to secure an equitable division of the heavy taxation necessary, or (*b*) where the limit of productiveness with regard to the several taxes would have to be exceeded, or finally (*c*) where for political reasons it is inexpedient to press heavily on the taxpayers. Under any of these conditions, resort to loans as a supplement to the tax revenue even for a somewhat lengthened period is defensible.[1]

It will be observed that the above statement refers to public borrowing for other than economic purposes. With reference to the policy of borrowing for economic purposes the same writer states:

> Actual purchase of productive property or creation of revenue-yielding works may fairly be defrayed by loans. The property or particular work may be regarded as the primary object of the debt, and is at hand to pay the interest on it. What we have called "economic" outlay has a claim to be met by borrowing that does not hold in respect to other forms. Taxation imposed for the purpose of adding to the domain has the disadvantage of taking the citizens' wealth for the purpose of accumulation, and should be employed sparingly if at all. To meet the cost of the purchase of the Prussian railways, or even of the English telegraphs, by immediate taxation would not, were it practicable, be correct."[2]

Shirras.—Another writer in this same field, living in Bombay, India, whose work bears the date 1924, presents some very clear-cut and definite ideas on the nature of public credit. Professor Shirras suggests that when that which should be charged to capital is charged to revenue, it is not only an injustice to the taxpayer, but is also faulty bookkeeping. Expenditure chargeable to capital is justified, he states, under three conditions: first, for permanent productive investment, such as the construction of public works which give the prospect of a return on capital over a long period of years; second, in an extraordinary emergency such as war; and third, in cases of temporary necessity such as casual deficits and wasting assets.

With reference to capital expenditure for productive purposes the following statement is pertinent:

[1] BASTABLE, "Public Finance," p. 629.
[2] *Ibid.*, pp. 620–621.

It is unfair to ask the taxpayers of a single year to bear the entire burden of works which will be a source of profit as well as a benefit to the community over a period of years. In most cases the taxpayers would be unable to meet such a demand . . .

Loans for capital expenditure should be fixed within such limits as will make the payment of interest and the gradul repayment of the principal over a stated period, *i.e.*, by the operation of a sinking fund, a certainty. In regard to local authorities, such as municipalities, it is often advisable to limit even arbitrarily the amount of the debt which these authorities may legally contract, *e.g.*, a fixed percentage of the assessed valuation of its real estate. It is sound policy to make provision for the gradual repayment of the loan from an early period of its currency. The payments may be spread over even 80 years, according to the nature of the undertaking and the length of time for which its utility is to endure. If the original form of the capital is an asset which is liable to become antiquated in, say, 40 years, the sinking-fund payments should be such as to extinguish the debt within that period. It is not essential that sinking-fund payments should take place from the first year of the loan. Indeed, it is often convenient to postpone these payments until the concern for which the capital was raised is in working order. The construction of the work should be pushed on rapidly, as small grants are to be condemned not only from the engineering, but from the financial, point of view. Commercial methods should be adopted from the outset.[1]

Lutz. This subject being so important, a brief quotation is presented from a leading American writer on the subject of public finance. Professor Lutz is not inclined to take extreme or radical positions on any question of this nature. After commenting on ultra conservative and equally radical points of view he writes in the following manner:

The usefulness of the loan depends on the usefulness of the purposes to which it is devoted. The true function of public credit is to serve as a supplement to the current revenues under certain conditions. These conditions will be more fully discussed below. Here, we desire simply to emphasize the proposition that the public loan is proper or not, according to the circumstances which give rise to its use. Credit is the handmaiden of taxation, never its peer as a financial resource. It is a useful and important device for meeting financial burdens that are too great for the immediate capacity of the revenue system, which are of such nature as to warrant equalization of the load over a period of time.[2]

[1] Shirras, "The Science of Public Finance," pp. 92–93, 1924.

[2] Lutz, "Public Finance," p. 515, 1924.

Basic Considerations.—Little thought needs to be given to the optimistic theories of such writers as Berkeley, who states a public debt is "a mine of gold"; Melon, a French mercantilist, who wrote that a debt is simply a case of the right hand owing money to the left; Pinto, who believed that "magic of credit and of the circulation of money has produced this mass of wealth by successive operations with the same coins"; and J. Cooke's notion that a public debt is a public blessing.[1] Hidden away in a bushel of the familiar chaff of economic error, there are a few grains of truth even in these panegyrics and others of like tenor that might be quoted. A public debt is a public blessing under proper restrictions and the right conditions. When extended according to sound principles, both technical and financial, for the construction of the right kind of capital improvements, a public debt not only may, but usually does, produce wealth. Indeed, a public debt of this type can be economically justified on no other basis. Under normal conditions and proper management, a given capital improvement should produce earnings sufficient to liquidate the debt and yield a profit, which, capitalized at the current rate gives the amount of wealth that has been produced.

Wealth Production.—The justification for expending the proceeds from current taxes or the sale of bonds in highway construction is that the highway is a producer of wealth. In common business parlance, a highway earns money if it is of the proper type and located in the right place. It produces wealth day after day and month after month. Public officials have no right to spend money on a given highway except to the extent that the highway does produce wealth. A possible modification of this hypothesis might be made because good roads facilitate the development of rural public schools, and permit a much richer and more varied rural social life; but these are real factors in the production of wealth, and the statement that a highway produces wealth takes into consideration certain educational, recreational, and social advantages that accrue as a partial product, as well as considerations of a purely economic character.

A factory or farm that produces wealth necessitates certain maintenance or upkeep charges as well as capital outlay. The same is true of a public highway.

[1] For quotations see Bullock, "Selected Readings in Public Finance," pp. 822–829, 1920.

A highway, therefore, has an earning capacity or produces wealth, and its earning capacity can be measured with at least a reasonable degree of accuracy. On the one side of the ledger is the cost of construction and maintenance, paid for either out of current taxes, or by the proceeds of the sale of bonds, which may mean increased taxes for a certain period of years to pay for a capital improvement; and on the other side the reduced cost of transportation of passengers, raw materials, or finished products. In addition the educational, recreational, and social advantages resulting from the improvement tend to increase human efficiency and lower the cost of production. To determine whether a certain expenditure for road purposes is wise or unwise, it is only necessary to measure the earning capacity of the improvement as contrasted with its cost of construction and maintenance. The sale of bonds for the construction of roads is no more than the financing of capital improvements for definite economic purposes, the return from which can be known and measured. This conception is the first step toward an understanding of the true nature of scientific highway finance.

Life of Highway Bonds.—The questions may now very properly be asked, how long should highway bonds run? Is it possible to put an arbitrary limit? What are the underlying principles that should be taken into account in arriving at a sound judgment regarding this matter? Obviously, the one thing to be considered is the nature of the capital improvement which is to be financed by selling bonds to be paid for in increased taxes over the period of years represented by the life of the bonds.

The grades on a highway may be reduced by a succession of cuts and fills involving a relatively large expenditure. If the work is done on the basis of the principles of highway engineering and is properly maintained after completion, the cuts and fills will be there, perhaps in even better condition, a hundred years from now. If no other class of highway improvements were to be considered, bonds could no doubt very properly be sold to be paid in half a century; but many forms of capital improvement represented by the construction of public highways are not so permanent in their character, and for some types of construction it would be improper to issue bonds having a life of more than 5 years, and for other types bonds should not be issued at all. The life of bonds should be such that the improvement represents a substantial equity throughout the life of the bonds. Drainage

is another reasonably permanent improvement. The road surface even when constructed of the most durable materials is perhaps the least permanent thing about a public highway. All things considered, it seems probable that about 20 years should represent the maximum life of highway bonds, and that for many types of construction bonds of shorter life should be issued.

Life of Improvement.—It has been a common practice among writers to suggest that bond issues should not extend beyond the life of a given improvement. A road once put to grade under the supervision of competent engineers represents a permanent improvement with but slight outlay for maintenance. This alone would not justify the floating of bonds having a life of more than about 20 years if the funds were to be used for grading, draining, and surfacing a road. One reason is that other parts of the capital investment represented by the construction of highways, have a much shorter life than the grading, perhaps in certain cases not even 20 years, possibly not more than 5 years.

A road that is once properly constructed should be maintained in a condition of 100 per cent serviceability, but this is exceedingly difficult to accomplish and is rarely achieved in practice. If it were done there would be no end to the life of a given improvement; but under the limitations imposed in public service, some deterioration is to be expected in a public highway, and the life of the bonds issued to pay for it should be based on the average useful life of the several components of the improvement as nearly as these can be estimated. The fallacy of the notion that the interest on bonds means an additional cost burden is shown in Chap. XVII.

Pay-as-you-go Policy.—Much has been said in recent years about what is called a "pay as-you-go" policy of road construction by which is meant that highways should be improved only as current funds are available. A large part of the discussion on this policy has disregarded the most elementary facts involved in the problem of highway finance. It has frequently been interpreted to mean that no highway construction should be financed by the issuance of bonds. Such a contention is just as erroneous as would be one that the maintenance of roads should be paid for from funds obtained by issuing bonds. When an improvement will last 10 or 50 years, possibly for a much longer period, a true "pay-as-you-go" policy does not mean that this particular improvement should be financed out of the current taxes of any

one year. To do so is not a pay-as-you-go policy, but on the contrary is a pay-before-you-go method of highway finance.

Nor should posterity be asked to pay for improvements that have worn out or become obsolescent. That is a pay-after-you-have-gone policy. A true pay-as-you-go policy points just as logically to the issuance of bonds for certain permanent capital improvements as it does to the financing of repairs and maintenance out of ordinary current revenue.

Highway Engineering.—A general analysis of the underlying factors involved, not only in the issuing of highway bonds, but also in fixing ordinary highway revenue would be incomplete without a brief reference to certain engineering considerations. Before any money is expended on a main road connecting market places, that road should be properly located by competent engineers. Great credit should be given the Bureau of Public Roads and our state highway commissions for the progress that has been made toward a proper classification of primary roads and location with reference to topography and the requirements of present and prospective traffic. If a road is not properly located now, as population and traffic increase it will have to be relocated which often involves economic waste. The most permanent thing about a public highway is its location, and that should be correctly fixed before funds are expended to install costly improvements.

Not only should roads be properly located, but sound highway finance demands that the construction be of a durability adequate for the traffic and be prosecuted at reasonable cost. If these elementary engineering principles are not followed, maximum return cannot be secured for the investment made by the public in the form of high tax payments and the anticipation thereof in the form of large bond issues. The same engineering and business principles should be observed in these matters as would be required in a properly managed private corporation undertaking capital improvements of a similar magnitude.

Traffic Surveys. It should be obvious that scientific traffic surveys must be made in order to arrive at a correct conclusion regarding the type of road surface that promises the largest earnings on the taxpayer's investment. Not only the number of vehicles per day, but also the weight and character of the vehicles should be known. Proper traffic regulation that will safeguard the investment is a necessary part of the problem of

highway finance. It is a waste of public funds to construct a pavement 6 or 7 inches thick on a foundation capable, with proper maintenance, of carrying existing traffic for an indefinite period, and then permit the road to be used by some heavier vehicle which will destroy the investment in a short time.

Research.—Behind the familiar activities attending the construction of roads and bridges is the painstaking work of the technically trained scientific investigator. Reference has already been made to the excellent research work that has been done by the Bureau of Public Roads, the various state highway commissions, and the engineering experiment stations of the land-grant colleges. What pavement is most practicable under a given set of traffic conditions? That is a technical question which can be answered only by the best-trained highway engineers, and even they are unable to give a correct answer to such a question unless complete and reliable and pertinent scientific data have been collected, tabulated, and interpreted. This was brought out a number of years ago when water-bound macadam and Telford roads which had been regarded as quite durable began to fail under motor-vehicle traffic. Not until a crop of papers and bulletins on dust preventives and roads preservatives appeared from the scientific investigator was it possible to make substantial progress in prolonging the life of these old roads. There followed studies of impact, the rate of wear of certain types of road surface under different traffic conditions, stresses in culverts and bridges, and a multitude of other technical subjects. If too large an amount of concrete or structural steel is used in a structure, or less than the correct amount is called for by the design under other conditions, economic waste is certain to follow, no matter how much care is exercised in the adjustment of current taxes and the floating of highway bonds.

The highway problem, therefore, must be considered both from an engineering and a financial viewpoint if the most efficient system of highway finance and administration is to be worked out.

The Opinion of Highway Officials.—In an address delivered before the Virginia Good Roads Association in 1923 on the subject, "Basic Principles of Highway Management and Finance," Thomas H. MacDonald, Chief of the Bureau of Public Roads, made the following suggestions regarding the issuing of highway bonds:

States in the initial stage of highway development should issue bonds to defer that portion of the annual charge for construction which would overburden either property or the road user.

States where original construction programs are well under way, can, in the main, finance further expenditures for construction by bond issues devoted to deferring the cost of special projects.

States where original construction is practically completed are concerned chiefly with maintenance and reconstruction, and should depend on current funds except in cases of emergency.[1]

The general principles discussed herein and the weight of official opinion relative to highway finance and administration are admirably summarized in the following resolutions which were adopted by the American Association of State Highway Officials, Nov. 20, 1924.

A new system of transportation, *highway transport,* has been established, and is being operated on a vast scale. Its relationship to other forms of transportation and its great utility within its recognized fields have been defined in their major aspects.

With the extensive and universal distribution of the motor vehicle, the general utilization of highway transport with satisfaction and relative economy is dependent upon the mileage of suitable highways. The suitability of highways, in turn, is determined by the adjustment of the public roads to the vehicles, or conversely, the vehicles to the roads. This objective raises at once all the big major problems of highway administration, equitable taxation of real property, public income and expenditures, regulations of motor vehicles, and many others. All of these received the earnest consideration of the committee, and this report upon administration and finance is predicated upon the recognition and acceptance of the following general principles of outstanding importance:

1. The public demand for highways is now so great, and the funds involved so large, that it is not possible to meet all demands in a limited period without too great a burden upon the public finance. Therefore, state funds available for new construction should be devoted first to the class of highways of greatest importance to the public under the jurisdiction of the state highway department.

2. The sum total of public roads should be considered, for financing purposes, in two major divisions; group one, general service motor highways, *i.e.*, general traffic flow lines; group two, local service roads.

3. Notice is taken of the extensive conversion of land that is taking place, especially in populous districts, *i.e.* the changes in the actual or potential utilization of land in which the establishment or availability

[1] "American Highways," vol. 3, 1, p. 30, January, 1924.

of motor transport is a major factor by which its value or its potential earning capacity is increased.

4. Notice is also taken of the special benefits which result from extraordinary highway undertakings in congested districts which may properly be financed, in part at least, by the formation of improvement districts with special assessments. As defined here, this principle is limited to conditions that are not average or normal, and does not apply to rural districts.

It is evident from the above that there are many conditions that will require special consideration. Also, the committee fully recognizes the fact that we have as yet the experience of only a few years available upon which to formulate sound and enduring policies. The situation is not crystallized. One new development succeeds another. It is certain, however, that the following statement of principles records and outlines those policies which have already proven sound, and which at this time embody the best practice.

Highway Finance

1. The highway budget is defined as the total annual expenditures in each state for highway purposes.

2. The annual highway budget should be adjusted to the relative needs for other public purposes.

3. No road should be improved by expenditure of public funds in excess of its earning capacity. The return to the public in the form of economic transportation is the sole measure of the justification for the degree of improvement.

4. Broad surveys made by the United States Bureau of Public Roads have determined conclusively that from 40 to 60 per cent of the average costs of highway construction is expended in permanent improvements, such as grading, draining, structures, engineering, and rights of way. Of the remaining cost, all but a small percentage of the surface can be salvaged in reconstruction and constitutes a definite addition to the capital facilities of the community which is passed on to the succeeding generations. From all these studies it thus appears that highway bond issues are justified where the "pay-as-you-go plan does not promptly provide the highways economically necessary, and where adequate engineering and economic control is assured.

5. The wide variance in the present status of highway development in the several states prevents the adoption of uniform policies for securing the funds necessary for the annual budget. Generally speaking, however, these principles may be set forth:

(*a*) States in the initial stage of highway development should issue bonds to defer that portion of the annnual charge for construction which would overburden either property or the road user.

(*b*) States where original construction programs are well under way can, in the main, finance normal new construction from current funds utilizing bond-issue funds to defer the cost of special projects.

(*c*) States where original construction is largely completed are concerned chiefly with maintenance and reconstruction, and should depend on current funds save in cases of emergency.

6. State highway bond issues should be serial in form and should mature over a period not exceeding 30 years.

7. Highway bonds issued by political subdivision of a state should be serial in form and should mature over a period not exceeding 20 years.

8. Serial maturities should be arranged so that the annual requirements of principal and interest will be as nearly uniform as practicable.

9. Sound public financing requires that where motor vehicle or other special levies are allocated to defray the costs of state highway bond issues, the full taxing power also of the state shall be authorized to guarantee principal and interest in event of failure of such special levies to provide sufficient revenue.

Highway Administration

1. The large sums involved in highway expenditures and the broad training and experience required in handling them demand that political patronage be eliminated in all highway administration. Stable organizations and policies are essential to the orderly progress of the highway program.

2. Highways of general motor use in each State should be classified into systems of like importance, such as interstate, state, and county highways. All others should be classified as local roads.

3. For the purpose of securing uniformity and economy, all expenditures on these systems should be correlated under adequate engineering and economic supervision.

4. The order, kind, and extent of improvement for each class and for individual projects in each class should depend upon the relative traffic requirements, present and future.

5. A much larger mileage of highways than at present should be immediately placed under adequate and continuous maintenance and made available for traffic the year around.

Distribution of Costs

1. The cost of building and maintaining adequate systems of highways should be distributed in an equitable relation to the benefits derived. These may be summarized as follows:

(*a*) Benefits to society in general, such as influence on education, recreation, health, fire prevention, police protection, the national defense, the postal service, living, and distribution costs.

(*b*) Benefits to definite groups, such as agriculture, manufacture, labor, railroads, mining, forestry, and waterways.

(*c*) Benefits to property served.

(*d*) Benefits to the road user.

2. For the purpose of apportioning costs in relation to benefits received, all highways may be divided into two classes; first, those used by the general motoring public, and, second, those which perform a purely local service function.

3. Special motor-vehicle taxes should be levied and used only for the improvement and maintenance of highways used by the general public; *i.e.*, for general highway traffic flow lines. They should be expended under the direction of the state highway department.

4. The wide variance in valuation, tax burdens, number of motor vehicles in use, and the status of highway development in the several states prevents the adoption of any fixed formula as to the proportion of the total costs of highways of general use which should be paid for from motor-vehicle funds. Generally speaking, however, these principles may be set forth:

(*a*) In states where the income from motor vehicles is insufficient to meet all of the maintenance costs of highways of general motor use without undue burden to the individual motorist, such funds should be applied first to the maintenance of interstate and state highway systems.

(*b*) In states where the income from motor vehicles is sufficient to meet all maintenance costs of highways of general motor use without undue burden to the individual motorist, any surplus should be used for this class of highway reconstruction and administration costs.

(*c*) In states where the number of motor vehicles will bring in large sums in excess of maintenance without placing undue burdens upon the individual motorist, such surplus should be used to defray all the costs of maintenance and a substantial share of all of the other costs of highways of general motor use.

(*d*) In those states where the motor-vehicle income is more than sufficient to meet maintenance costs of highways of general motor use without undue burden to the individual motorist, it may be found advisable to use such surplus for the purpose of defraying all, or part of, the costs of bond issues to expedite construction of economically desirable motor highways.

5. Roads of a purely local interest, serving only local needs, should be financed out of local revenues obtained from local general tax revenues. Special assessments on adjoining land to defray a portion of the costs of such roads may be justified.

6. Where extraordinary improvements are undertaken in the vicinity of, or serving, congested areas of population, the increment, if any, in property valuation following the improvement should be drawn upon to defray an equitable portion of the cost.

Form of Motor Taxes and Collection Methods

1. The motor-vehicle tax should be simple in form and distributed in equitable and just proportion between the different types of motor vehicles.

2. The state should be the sole agency levying special taxes upon the motor vehicle or the highway user.

HISTORY OF HIGHWAY BONDS

Massachusetts, New Jersey, and New York, the pioneer states in establishing state aid, also took the lead in providing for the issuance of highway bonds. In 1894 a law relating to state highways was approved in Massachusetts with the following provisions:

> For the purpose of meeting any expenses that may be incurred under provisions of chapter four hundred and seventy-six of the acts of the year eighteen hundred and ninety-three, as hereby amended, including the salaries and expenses of the commission, the treasurer and receiver-general is hereby authorized, with the approval of the governor and council, to issue scrip or certificates of indebtedness to an amount not exceeding three hundred thousand dollars, for a term not exceeding thirty years. Said scrip or certificates of indebtedness shall be issued as registered bonds or with interest coupons attached, and shall bear interest not exceeding four per centum per annum, payable semiannually on the first days of April and October in each year. Such scrip or certificates of indebtedness shall be designated on the face as the State Highway Loan, and shall be countersigned by the governor, and shall be deemed a pledge of the faith and credit of the Commonwealth, and the principal and interest shall be paid at the times specified therein in gold coin of the United States or its equivalent; and said scrip or certificates of indebtedness shall be sold and disposed of at public auction or in such other mode and at such times and prices and in such amounts and at such rates of interest, not exceeding the rate above specified, as shall be deemed best. The treasurer and receiver-general shall, on issuing any of said scrip or certificates of indebtedness, establish a sinking fund for the payment of said bonds, into which shall be paid any premiums received on the sale of said bonds, and he shall apportion thereto from year to year, in addition, amounts sufficient with the accumulations to extinguish at maturity the debt incurred by the issue of said bonds. The amount necessary to meet the annual sinking fund requirements and to pay the interest on said bonds shall be raised by taxation from year to year.[1]

[1] *Fourth Annual Report of the Massachusetts Highway Commission*, pp. 87–88, 1897.

New Jersey.—By 1895 both New Jersey and New York had enacted laws providing for the issuance of highway bonds. In New Jersey the success of the good-roads movement at this time, under the county bonding law, led to the passage of an act authorizing townships to issue bonds for the construction of roads. In the report for 1894 it is recorded that about 12 miles of roads radiating from Moorestown, Chester Township, of widths varying from 9 to 14 feet, and from 6 to 8 inches deep had been constructed under the provision of the township law at an expense of $40,000, the same being paid for by an issue of 5 per cent township bonds.[1] Under the provisions of the county bonding law, Union and Passaic counties had constructed a complete system of macadam and Telford roads. The enterprise and progressive spirit manifested by these counties gave a strong impetus to the good-roads movement not only in New Jersey but in the nation at large.

New York.—As early as 1902 the project of a $10,000,000 road bond issue for the state of New York was considered in a good-roads convention held in the city of Albany. Regarding the suggested bonding system, the following statement may be instructive:

> While great progress has been made in the work of improving our public highways, it has been suggested that some method should now be adopted by which a system could be put in operation for the purpose of improving within a very few years such a part of the principal roads in the state as would be of most benefit to the greatest number of citizens, and that this improvement should be conducted in a more expeditious manner than is now possible. To do this would require a larger annual expenditure on the part of the state than has yet been made, and if paid at one time would impose a larger burden upon the state than it would be wise to inflict in one, two, or even five years. The work which is being done is not only for the present, but for all time; and many, therefore, advocate an issue of state bonds for the purpose of improving our public highways under the provisions of the present State-aid Act, claiming that this would fulfill two important requirements—first, there would immediately be available a sufficient sum to provide for the improvement within the next three or four years of a large proportion of the principal roads which are worthy of improvement, and, secondly, it would distribute the cost of such improvement over a term of years, making the annual payment so small as to be scarcely percepti-

[1] *First Annual Report of the Commissioner of Public Roads of New Jersey*, p. 9, 1894.

ble, and allowing those who would benefit by the work in the future an opportunity to help pay for its construction.

The funds derived from the sale of these bonds could be used for the purpose of paying the total cost of improvement of highways, and the counties' share could be returned to the state in payments extending over a term of years equal to that over which the bonds extended . . .

The average annual payment which would be required to retire such a ten-million bond issue, both principal and interest, would be about $760,000, being a state tax of not to exceed 6 cents per $1,000 based on present conditions, and assuming that each county received its pro rata share a county tax of not to exceed 17 cents per $1,000 for the above period of seventeen years.[1]

Bonds to 1904.—From these beginnings, small though they were when judged by modern standards, the practice of issuing state, county, and other local highway bonds has grown to its present proportions. During the year 1904 the counties, townships, and districts in the states of Indiana, Minnesota, Ohio, Tennessee, and Texas expended $3,530,470 from road bond issues. In several other states bonds were issued for road improvement, but the exact amount is not of record. It is recorded that in the amount expended from bond issues, Indiana stood first with $1,342,418.95; Texas second, with $936,395.79; and Ohio third, with $843,753.64. In the states listed above, $21,000,000 in bonds were issued for road improvement during the years from 1894 to 1904.[2]

Later Bond Isssues.—Between 1904 and 1909 New York increased its mileage of improved roads from 5,876 to 12,787, due partly to the fact that about $5,000,000 a year had been provided from a $50,000,000 state bond issue for trunk-line highways in addition to expenditures of local revenues of about $5,000,000. By Jan. 1, 1915, the state and local road bonds and bridge bonds outstanding for the country at large had increased to $344,763,082, comprising $115,324,500 of state bonds and $229,438,582 of local bonds. State bonds had been issued in California, Connecticut, Idaho, Maine, Maryland,

[1] U. S. Department of Agriculture, Public Road Inquiries *Bull.* 22, *Proc. of the Third Annual Good Roads Convention of the Board of Supervisors of the State of New York*, p. 42, 1902.

[2] U. S. Department of Agriculture, Office of Public Roads, *Bull.* 32, "Public Roads Mileage, Revenue, and Expenditures in the United States in 1904," p. 18.

Massachusetts, New Hampshire, New York, Rhode Island, Utah, and Washington, and were authorized in New Mexico in 1912, but not sold until 1915. It appears that the constitutions of Kansas, South Dakota, and Wyoming at that time prohibited these states from participating in works of internal improvement and consequently from issuing state bonds for the construction of public highways.

Bonds, 1915 and 1922.—Table XVI[1] gives by states the road and bridge bonds outstanding Jan. 1, 1915, and 1922. It will be observed that in 1915 New York ranks first with a total highway bonded debt of $76,822,088 of which $65,000,000 was state bonds and the balance local bonds. Indiana ranks second with a local bonded debt of $3,095,357.43, and California third, with $32,277,000, of which $18,000,000 was state bonds and the balance local bonds. By this time the method of meeting the cost of permanent road construction from bond issues, both local and state, had become well established.

The table shows that by Jan. 1, 1922, there had been a very substantial absolute increase, but not a relative increase, in the amount of highway bonds. In some states the increase was both absolute and relative. The states having the largest state and local bond issues were as follows:

New York, $121,681,100; California, $101,258,000; and Texas, $96,517,900. Colorado, North Dakota, and Vermont are the only states not reporting local bonds for highway purposes. Colorado, however, reports $2,000,000 of state bonds. Twenty-one of the states report the issuance of state bonds, New York being first with $100,000,000; California second, with $55,400,000; and Pennsylvania third, with $50,000,000.

In every state except North Dakota and Vermont, some of the road money was secured from the sale of state or local bonds. Arkansas, West Virginia, and Louisiana secured 70.2, 69.1, and 68.1 per cent, respectively, of their total road income from bonds, while in New Hampshire and Connecticut only about 3 per cent of the highway revenues was derived from this source. Arkansas, Louisiana, Oklahoma, and Texas taken together obtained 59.3 per cent of their highway funds through public borrowing, while in the New England group of states only 12.7 per cent was derived from the sale of bonds.

[1] U. S. Department of Agriculture, Departmental *Bull.* 1279, "Rural Highway Mileage, Income and Expenditures," p. 80, 1921 and 1922.

TABLE XVI.—HIGHWAY BONDS FOR RURAL ROAD AND BRIDGE PURPOSES OUTSTANDING JAN. 1, 1915, AND JAN. 1, 1922

State	Outstanding Jan. 1, 1915			Outstanding Jan. 1, 1922		
	Total state and local bonds	State bonds	Local bonds	Total state and local bonds	State bonds	Local bonds
Alabama	$ 5,418,000.00		$ 5,418,000.00	$ 8,758,500		$ 8,758,500
Arizona	295,000.00		295,000.00	18,501,000		18,501,000
Arkansas	1,467,066.00		1,467,066.00	50,955,700		50,955,700
California	32,277,000.00	$ 18,000,000	14,277,000.00	101,258,000	$ 55,400,000	45,858,000
Colorado	90,500.00		90,500.00	2,000,000	2,000,000	
Connecticut	7,000,000.00	7,000,000	(b)	400,000		400,000
Delaware	1,280,000.00		1,280,000.00	7,144,000	3,929,000	3,215,000
Florida	5,959,199.00		5,959,199.00	24,130,200		24,130,200
Georgia	127,500.00		127,500.00	15,659,000		15,659,000
Idaho	1,339,000.00	505,000	834,000.00	19,772,200	c3,615,500	16,156,700
Illinois	798,761.55		798,761.55	20,617,300	5,000,000	15,617,300
Indiana	43,095,357.34		42,095,357.34	62,415,900		62,415,900
Iowa	1,960,780.00		1,960,780.00	25,677,800		25,677,800
Kansas	(b)	(b)	(b)	9,182,400		9,182,400
Kentucky	705,000.00		705,000.00	7,135,800		7,135,800
Louisiana	1,588,835.00		1,588,835.00	28,571,400		28,571,400
Maine	785,000.00	785,000	(b)	6,439,300	6,264,500	174,800
Maryland	12,853,700.00	12,410,000	443,700.00	18,212,900	15,700,000	2,512,900
Massachusetts	10,305,522.82	8,699,500	1,606,022.82	26,820,800	8,097,500	18,723,300
Michigan	10,389,029.43		10,389,029.43	55,234,200	20,000,000	35,234,200
Minnesota	1,411,889.00		1,411,889.00	21,402,600		21,402,600
Mississippi	8,327,172.00		8,327,172.00	37,912,400		37,912,400
Missouri	522,500.00		522,500.00	14,942,600		14,942,600
Montana	2,221,050.72		2,221,050.72	9,775,800		9,775,800
Nebraska	(b)		(b)	2,848,000		2,848,000
Nevada	38,000.00		38,000.00	1,438,000	600,000	838,000
New Hampshire	675,000.00	675,000	(b)	570,100	225,000	345,100
New Jersey	14,011,337.00		14,011,337.00	25,833,000		25,833,000
New Mexico	157,000.00	(c)	157,000.00	2,001,100	1,420,000	581,100
New York	76,822,088.00	65,000,000	11,822,088.00	121,681,100	100,000,000	21,681,100
North Carolina	8,955,300.00		8,955,300.00	55,808,500	10,552,600	45,255,900
North Dakota	(b)		(b)			
Ohio	31,175,968.53	(b)	31,175,968.53	70,936,500		70,936,500
Oklahoma	1,440,000.00		1,440,000.00	11,547,600		11,547,600
Oregon	1,615,000.00		1,615,000.00	42,891,300	31,700,000	11,191,300
Pennsylvania	27,547,659.00		27,547,659.00	50,000,000	50,000,000	(a)
Rhode Island	1,800,000.00	1,800,000	(b)	2,952,000	2,600,000	352,000

South Carolina	460,000.00	. . . .	460,000.00	13,081,000	. . . . .	13,081,000
South Dakota	(b)	(d)	(b)	3,649,000	3,500,000	149,000
Tennessee	6,898,277.00	.	6,898,277.00	28,693,500	. . . . .	28,693,500
Texas	14,615,017.00	. . .	14,615,017.00	96,517,900	. . . . .	96,517,900
Utah	541,500.00	260,000	281,500.00	11,785,200	7,000,000	4,785,200
Vermont	(b)	. .	(b)			
Virginia	5,650,994.93	. . . .	5,650,994.93	14,936,300	. . . . .	14,936,300
Washington	1,555,000.00	190,000	1,365,000.00	20,547,900	. . . . .	20,547,900
West Virginia[h]	1,303,000.00	. . . . .	1,303,000.00	37,727,900	15,000,000	22,727,900
Wisconsin	281,078.00	. . . .	281,078.00	10,201,600	. . . . .	10,201,600
Wyoming	(b)	(d)	(b)	3,745,000	2,970,000	775,000
Total	$344,763,082.32	$115,324,500	$229,438,582 32	$1,222,312,300	$345,574,100	$876,738,200

[a] All data is for fiscal year ending June 30, 1921, except that for total outstanding state bonds which is for calendar year.
[b] No bonds reported.
[c] Outstanding Sept. 30, 1922.
[d] Constitution prohibits the state participating in works of internal improvement.
[e] In 1912 legislature authorized $500,000 state bonds, but none sold until 1915.
[f] State bonds only.
[g] No data.
[h] Up to July 1, 1915.

It appears that complete data as to the payment of principal and interest on highway bonds could not be secured for all the states even as late as 1922. One factor is the custom, which is quite general in a few states, of charging all bond interest to the cost of construction for the period from the time bonds are sold until the construction work on a given road is completed. In some states, it is not possible to segregate interest payment on highway bonds, due to the fact that these bonds are not designated as highway bonds but simply general bonds against a given municipality. The Bureau of Public Roads estimates that approximately $5,750,000 of interest and principal is being paid out annually on general bonds, which means that a grand total of the annual payments for principal and interest on highway bonds is $95,000,000, of which approximately $60,000,000 is for interest and $35,000,000 for principal.

In 1921.—During the year 1921 new highway bond issues were authorized to the extent of $187,260,200, while the sale of bonds, including those previously authorized, amounted to $303,572,800. At the close of the year 1921 the grand total of all outstanding highway bonds, so far as could be determined, amounted to $1,222,312,300, of which $345,574,100 were state bonds and $876,738,200 bonds issued by counties, townships, or districts. The total expenditures for all rural highway purposes in 1921 being $1,036,587,772, it thus appears that the total outstanding highway indebtedness at that time was only about 18 per cent in excess of the highway expenditures for that year. In 1914 highway indebtedness had exceeded highway expenditures 43 per cent, which indicates a substantial decrease in the relative amount of highway bonds.[1]

HIGHWAY BONDS OF ILLINOIS

Since 1922 Illinois has superseded New York as the state having the largest bonded debt for highway purposes. Frank T. Sheets, Chief Highway Engineer of Illinois, contributes an article entitled "To What Extent May a State Economically Issue Bonds for Road Construction?" A number of the general principles of highway finance and administration outlined herein are given very concrete endorsement in this article. Mr. Sheets speaks of the importance of the proper location and the proper classifica-

[1] *Ibid.*, pp. 1–13.

tion of the public highways. On the latter point the following statement is very suggestive:

> In general, a state highway system on which bond-issue funds are to be expended should not exceed 10 per cent of the public road mileage of the state. In a majority of cases this mileage will carry 95 per cent of the state's highway traffic, and development in excess of this mileage by means of the state bond issue plan may well be deferred until such a system shall have been completed or at least financed.[1]

Serial Bonds.—Other suggestions from Illinois that are in harmony with sound principles of highway finance may be briefly enumerated. Highway bonds should be serial in form and should run for a period less than the life of given improvement but not exceeding 30 years. Continuous and adequate road maintenance must be provided. No state should issue highway bonds unless the highways purchased will yield annual dividends in the saving of transportation costs in excess of the annual principal, interest, and maintenance charges for the said highway improvement, nor should a state issue highway bonds unless the payment of the principal and interest can be financed without burdensome taxation. Finally, the outstanding importance of the expenditure of a sufficient amount of funds for scientific highway research is not only appreciated but given sympathetic and very positive support.

Bond Issues.—Two large bond issues for highway construction purposes have been authorized by the legislature of Illinois. The first issue was for $60,000,000, and the second, $100,000,000. The highway system set up under the $60,000,000 bond issue voted in November, 1918, consisted of 4,700 miles. The highway system provided under the recent bond issue of $100,000,000 adds 5,100 miles, making a total of 9,800 miles. The latter bond issue is to be financed entirely by auto license fees, which means that no direct property tax will be levied.

Wealth Production.—It will be recalled that certain writers on public finance have referred to a public debt as a public blessing which, by some process of magic, is a producer of new wealth. It was remarked in that connection that even the most extreme panegyrics of public-borrowing optimists contain a few grains of the pure gold of economic truth. It is estimated that the earnings of the Illinois paved road system will be $64,430,000, as

[1] "American Highways," vol. 4, 1, pp. 12–13, January, 1925.

long as the traffic averages 500 vehicles per day. Should the traffic reach an average of 1,000 vehicles per day, which may be reasonably expected, the gross saving on transportation costs will be approximately $129,000,000 per year.

These figures not only reveal the inherent weakness of what is erroneously regarded in many quarters as a pay-as-you-go policy of highway finance, but also afford the very best and most concrete testimony of the fact that a good road is a producer of wealth quite as much as either a farm or a factory. In Illinois it appears that to finance this vast bond issue an average license fee of about $9.90 per car per year is levied, as compared to the averages of about $11.70 per car,[1] for the United States. During the period in which the road bonds are to be retired in Illinois, it is estimated that there will be an average of about 1,400,000 motor vehicles. Dividing the gross saving among this number of motor-vehicle users, the result indicates a saving of $46 per user. On this basis the motorist will pay in license fees $9.90 per year and get back $36.10 per year in savings over and above the amount paid in, which amounts to 365 per cent on his yearly investment. If the traffic should average 1,000 vehicles per day, the net saving as estimated will be increased to $82.10 per year, or 830 per cent on the investment.

HIGHWAY BONDS OF CALIFORNIA

In 1910 California passed its first State Highway Act providing for a bond issue of $18,000,000 to build a specific trunk-line system of highways and laterals to the county seats. Serial bonds running for a maximum of 45 years and bearing interest at the rate of 4 per cent were issued for this purpose. In 1916 a second road law was passed providing for a bond issue of $15,000,000 in 4.5 per cent, 40-year serial bonds.

Bond Amendment.—At a special election held July 1, 1919, a constitutional amendment was adopted providing for the issuance of state highway bonds to the amount of $40,000,000 to complete the projects contemplated by the two previous state highway bond issues and to construct thirty new projects specified in the constitutional amendment. These were to be 4.5 per cent, 40-year, serial bonds. It is interesting to note that the premium on the third bond issue of $40,000,000 amounted to $1,332,250

[1] *Ibid.*, p. 14.

as contrasted with $2,129 premium on the first bond issue and only $25 on the second. The total funds available from the various state highway bond issues of California, including premiums, have amounted to $74,334,404, which has certainly proved one of the leading factors in making California a fine example of a good-roads state.

Highway Finance.—In "Study of the State Highway System of California," by the Highway Advisory Committee, published in 1925, there is a very complete and scientific statement of some of the leading principles of highway finance and administration. The discussion of highway finance opens with the following:

> State highway construction in the past has been financed from bond issues and federal aid. Now that bond funds are exhausted, some fair and practicable method of financing the remaining new construction must be selected if work is to continue.
>
> If roads are to be built, they must sooner or later be paid for by the people of the state. Taxpayers have never been enthusiastic over paying any form of taxes, but they are insisting upon having the roads. Therefore, it becomes a case of selecting from the various available methods of taxation that method which will prove to be the most equitable and come the nearest to being popular with the people who pay.[1]

It is true that no method of taxation ever has been devised which fully harmonized with the requirements of both the faculty principle and the benefit principle of taxation. In some cases one predominates and in some cases the other is the more important factor. The committee suggests that the building of all state highways, and all county roads of general motor use will produce direct or indirect benefits, which may be classified as benefits to all functions of organized society in general; benefits to definite groups, such as labor, agriculture, and the various industries; benefits to property served; and, finally, benefits to the road user himself. These benefits are in the inverse order of that stated, the greatest benefit being to the road user, and next, the property served. In conformity with these general principles, taxation for roads usually has been assessed to the general public, property, and the road user.

[1] *Report of a Study of the State Highway System of California* by the Highway Advisory Committee, p. 50, 1925.

Of late, however, attention is being directed to the fact that the burden of taxation on property has become excessive. The demand of road users for such large road-building programs as are now necessary resulted in a gradually increased tax on the road user. Before it is possible to arrive at any basis for the distribution of various forms of highway taxation in a great state like California, it is necessary to ascertain the essential facts and interpret their true meaning. It would appear that the committee whose report is referred to went about this task in a very thorough and scientific manner.

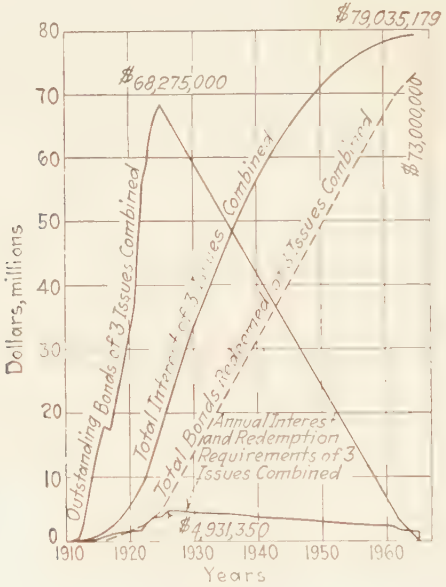

Fig. 6.

Road Systems. According to the census taken by the Bureau of Public Roads, the combined state and county road systems of California on June 30, 1923, contained 7,021 miles of hard-surfaced roads, one-third of which had been improved with bituminous macadam and two-thirds with higher-type pavement, while an additional 7,400 miles had been surfaced with gravel or macadam. By 1924 the state itself had paved a total of only 2,077 miles and had improved an additional 1,366 miles with gravel or macadam. This in itself is sufficient evidence of the

general fact that the counties have made very heavy expenditures, mostly from property taxes, for the construction of roads used by motor vehicles.

Expenditures.—What has been the method of financing these improved county and state roads? Table XVII gives an analysis of expenditures for construction and maintenance of state and county roads and bridges, showing source of revenue for the fiscal years from 1912 to 1923 inclusive.[1] Out of a grand total expenditure from all sources of $269,392,357 during this period, $36,967,364 was obtained from a tax on motor vehicles, or 13.7 per cent; and $232,424,993 from the general tax, or 86.3 per cent. It also will be noted that the sources of the so-called general tax were: first, a state corporation tax of $62,652,296, or 23.3 per cent; a property tax of $163,216,574, or 60.6 per cent; and federal aid, $6,556,123, or 2.4 per cent. These figures do not include the cost of financing the construction of pavements in the streets of towns and cities, which is met either by direct taxes on property or by special assessments on abutting property, and it is reasonably safe to state that even in California, with relatively heavy corporation taxes, the property tax has been paying at least two-thirds of the entire burden for the construction of roads and bridges. This conforms with very close precision to the estimate already made that in the country at large property taxes are paying approximately two-thirds of the burden of highway finance.

Table XVIII gives essentially the same data except that total expenditures for roads and bridges are included for each year beginning 1912.[1] The motor vehicles have been contributing 13.7 per cent, and general taxes 86.3 per cent of the highways tax burden in the state of California. Finally, of the $269,392,357 of total expenditures, $62,274,097 was obtained by the issue of state highway bonds.

Increased Taxes.—With these facts before it, the Committee outlined a general policy of highway finance. In the main, this includes a study of property taxes, motor vehicle taxes, and bond issues. The general policy favored is an increase of taxes on motor vehicles, and the discontinuance of a policy of bond issues for highway purposes except when a given improvement on the primary system is considered so urgent and of such a permanent character as to justify a special and sure means of financing.

[1] *Ibid.*, p. 51.

TABLE XVII.—ANALYSIS OF EXPENDITURES FOR CONSTRUCTION AND MAINTENANCE OF STATE AND COUNTY ROADS AND BRIDGES SHOWING SOURCE OF REVENUE FISCAL YEARS 1912 TO 1923, INCLUSIVE

Item	Grand total expenditure from all sources	From tax on motor vehicles	Total from general tax	Source of general taxes		
				State corporation tax	Property tax	Federal aid
State highway bonds	$ 62,274,097		$ 62,274,097	$62,274,097		
Legislative appropriations	378,199		378,199	378,199		
Federal aid	6,556,123		6,556,123			$6,556,123
County contributions to state	1,024,057		1,024,057		$ 1,024,057	
County expenditures	162,192,517		162,192,517		162,192,517	
Motor vehicle taxes—counties	20,972,527	[a]$20,972,527				
Motor vehicle taxes—state	15,994,837	15,994,837				
Totals	$269,392,357	$36,967,364	$232,424,993	$62,652,296	$163,216,574	$6,556,123
Percentages of total	100	13.7	86.3	23.3	60.6	2.4

[a] Total apportionment to counties to June 30, 1923, but not all expended.

TABLE XVIII.—TOTAL STATE AND COUNTY EXPENDITURES FOR CONSTRUCTION AND MAINTENANCE OF STATE AND COUNTY ROADS AND BRIDGES SHOWING GENERAL SOURCE OF FUNDS
(Not Including San Francisco County)

Organizations	Fiscal year ending June 30	Total expenditures for roads and bridges	General sources of revenue			
			Motor vehicles		General taxation	
			Amount	Per cent	Amount	Per cent
Counties.....	1912	$ 6,228,526				
Counties.....	1913	9,495,281				
Counties.....	1914	9,615,882				
Counties.....	1915	12,489,799				
Counties.....	1916	16,106,469				
Counties.....	1917	15,059,232				
Counties.....	1918	14,649,867				
Counties.....	1919	12,350,569				
Counties.....	1920	14,850,762				
Counties.....	1921	25,749,867				
Counties.....	1922	24,624,643				
Counties.....	1923	21,944,147				
Counties total.....		$183,165,044	*$20,972,527	11.4	$162,192,517	88.6
State total, fiscal years 1912–1923.....		86,227,313	15,994,837	18.6	70,232,476	81.4
Grand total.....		$269,392,357	$36,967,364	13.7	$232,424,993	86.3

* Total apportionment to counties to June 30, 1923, but not all expended.

First of all, the policy of financing additional permanent road improvements through a general state bond issue is rejected for reasons which may be briefly summarized.

Attention is called to the fact that the peak of combined payments for all bond issues will be reached in 1926 with the payment of $4,931,530 for interest and sinking fund. The cost of all bond issues for principal and interest will reach $132,035,179, and the payment period will extend to 1965. The rate of annual payment on the three bond issues combined and the outstanding bonds and total interest at the end of each fiscal year for each issue are shown by Fig. 6. The general facts brought out by the curves presented are self-explanatory.

Status Bond Issues. Figure 7 shows the fluctuation in annual expenditures and of rates of annually completed road mileage as recorded to June 30, 1924. It is pointed out that this fluctuating rate of expenditure has prevented the construction forces of the state from maintaining their business on the most efficient basis. Modern highway construction is a highly specialized business which should be sufficiently continuous to retain in the service

experienced contractors and engineers. While it is true that continuous production is highly essential, especially in a technical business, it does not necessarily follow that the policy with reference to floating highway bonds has been the only cause or even the most important cause of the fluctuating rate of expenditure indicated on this figure. Nor does it follow that the floating of large issues of highway bonds has been, even indirectly, an important factor in the improper location or classification of public highways. It already has been pointed out that one essential is the proper location of a given primary road. If that is not done, highway expenditures will be partially wasted, whether the revenues are obtained from property taxes, motor-vehicle

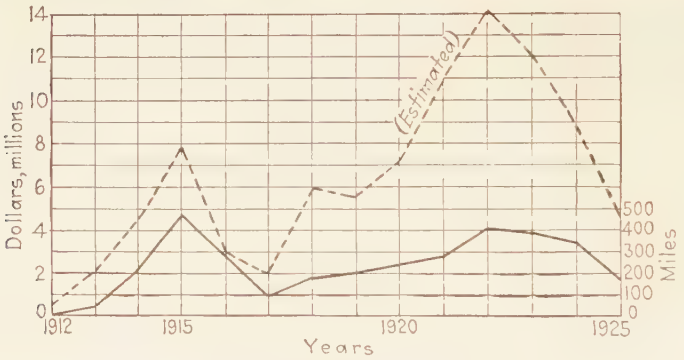

FIG. 7.

taxes, or bond issues. As a general rule, politics is at least the first, second, and third reason why roads are not properly located. It is quite evident that the three bond issues in California, amounting in the aggregate, including premiums, to over $73,000,000, were pushed through in a somewhat hurried manner and without a proper regard for all of the fundamental principles of highway finance and administration which have been reviewed. Even with some possible slight disregard of the leading canons of highway finance, it is quite certain that the improved highways made possible by the bond issues have been highly productive in building up the wealth of California.

Bond Expenditures. Figure 8 shows the relation of annual expenditures to the annual interest and redemption requirements of the three bond issues combined. In view of the fact that $133,104,550 remained to be paid for principal and interest

on the existing bond issues at the close of the fiscal year 1924, for roads already constructed in the state of California, and in view of the general desire of the people to reduce rather than increase rates of general taxation, the judgment of the committee is sound. It is that for the present a sufficient additional burden will be placed on this source of revenue by the $25,000,000 new bond issue recommended for major bridges and the elimination of railroad grade crossings. This does not mean that under other

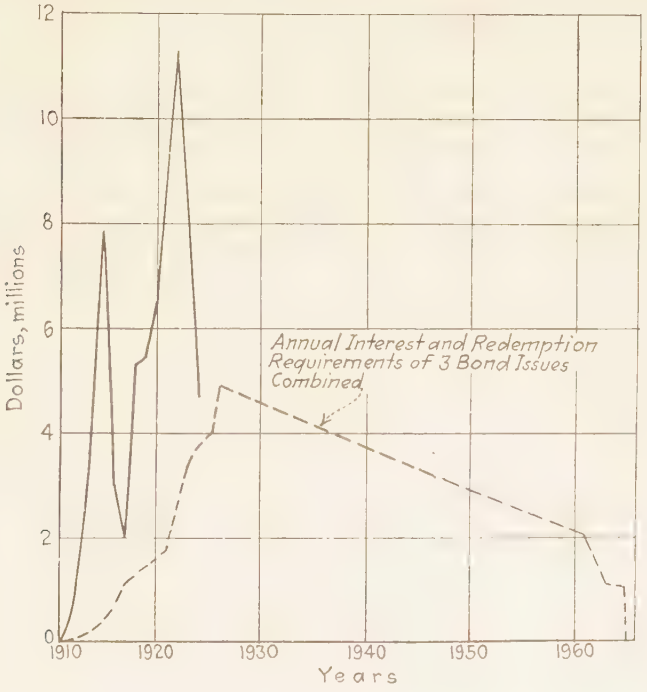

FIG. 8.

and very different conditions large bond issues are not desirable. Having pushed forward in the past with a policy of bond issues, it will no doubt make a better balanced system of highway finance, if, in the near future, increased taxes on motor vehicles are in the main used to complete the proposed improved road system of that state.

Typical Bond Issue.—Figure 9 gives the essential data for a typical $100,000,000 bond issue on the basis of 4.5 per cent interest, bonds to be sold at the rate of $10,000,000 per year, covering a

period of 10 years, thus insuring continuous operation, all bonds to be retired within 25 years from date of the first retirement, which would begin 5 years after the first issue.

Reference has already been made to the general plan of highway finance and administration through general taxes and also motor-vehicle taxes. In this connection it will be unnecessary,

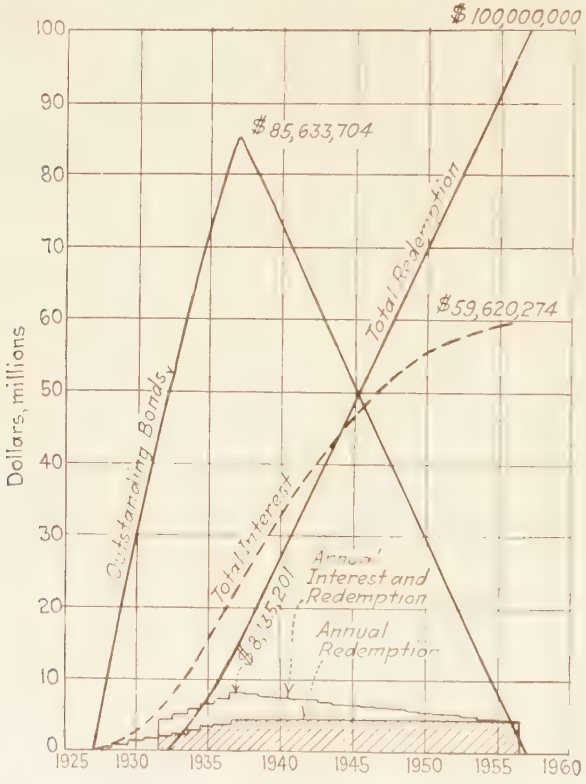

FIG. 9.

therefore, to do more than state the general conclusions of the committee along this line.

Recommendations. The recommendation that increased funds for the construction of public highways be obtained from additional taxes on motor vehicles is based on a careful analysis of transportation costs on improved roads as compared with the ordinary road. If it is true that a high-cost type produces earnings, the more durable and otherwise satisfactory the road

surface, the greater will be the earnings in reduced cost of transportation. Reference in this connection is made to experiments which indicate that not less than a 20 per cent saving in vehicle operating cost is realized on improved as compared with unimproved highways.

The estimates of reduced cost made by the committee as a basis of the recommendation that motor-vehicle taxes be increased will be of interest. It appears that during the first year's operation of the present gasoline tax in California, 638,474,583 gallons of gasoline were used by vehicles on highways. Assuming that on an average a registered vehicle secures 12 miles to the gallon, the distance traveled by the average vehicle is 5,675 miles per year. At an average total operating cost of 12.5 cents per mile on unimproved roads, including all items of expense, which means 10 cents per mile on improved roads, the total saving on improved roads would be $142 per car.

A cost of 12.5 cents per mile on unimproved roads and 10 cents per mile on improved roads means a total cost, for all motor vehicles in California, of at least $766,000,000, or an average cost per vehicle of $560 per year. Registration fees and gasoline taxation under the present law average $14.17 per vehicle, or only 2.5 per cent of the estimated average annual operating cost per vehicle. With motor-vehicle taxes increased $6.25 making a total of $20.42 per vehicle required to raise the $10,000,000 per year for 10 years to complete the road improvement program, the total tax on the vehicle is only 3.5 per cent of the estimated average annual operating cost per vehicle.

After presenting many other details regarding motor-vehicle fees and gasoline taxes, the committee makes the following recommendations:

> We recommend that the financing of state highway construction be changed from the expensive long-term-bond method to the "pay-as-you-go" method.
>
> We recommend the immediate refinancing to state highway construction by one or more methods which will insure a revenue of approximately $10,000,000 for the year 1926, with annual amounts increasing each year thereafter at the same rate as the increase in motor-vehicle registration, such revenue to be in addition to such construction revenue as may be made available from federal aid or supplementary bond issues.
>
> We recommend that the revenue for this construction program be derived from increased taxes upon motor vehicles, either by increasing

the plate tax, by a graduated weight tax, or by an increased tax on gasoline, or some combination of these forms of tax.

We recommend the selection of that form of taxation on motor vehicles which will be the most equitable and the most acceptable to those who pay the tax.

We recommend that increases in motor-vehicle revenue be made available entirely to the state for highway construction.

We recommend that steps be taken by the legislature preliminary to placing before the voters at the next general election a bond issue of $25,000,000 in short-term bonds, all proceeds of which shall be used on the primary road system for the construction of major bridges and to defray the state's portion of the cost of the elimination of railroad grade crossings, in cooperation with railroads, the division of expense to be fixed by the California Railroad Commission for each grade crossing elimination project.[1]

California's Experience.—The bond situation in California has been presented in some detail partly because a number of mistakes were made which highway officials now recognize should be avoided, and partly because that subject is so ably presented in the report of the Highway Advisory Committee. The bonds should not have run 40 or 45 years, but instead, from 25 to 30 years at the most. More attention should have been given to a proper location and classification of the public highways. All things considered, including the heavy bond issue which will run until 1965, the inadvisability of a further bond issue in the near future becomes apparent, except in unusual cases, and the desirability of an increase of motor-vehicle taxes is justifiable on the principle that the road user receives the greatest special benefit from improved roads and therefore ought to bear a substantial share of the burden.

DIFFERENT TYPES OF BONDS

In 1917 L. I. Hewes, Chief, Economics and Maintenance, Office of Public Roads and Mr. Glover, Professor of Mathematics and Insurance at the University of Michigan, prepared a bulletin on Highway Bonds, the same being a compilation of data and an analysis of economic features affecting construction and maintenance of highways financed by bond issues. This study contains a clear and comprehensive analysis of the different types of bonds as they are related to the technical and

[1] *Ibid.*, p. 68.

economic phases of highway administration.[1] Statistical tables are presented making a comparison of serial, annuity, and sinking-fund bonds, which the student of highway engineering will find very instructive.

THE CONTROL OF BOND ISSUES

In the history of state and local public finance are recorded a number of methods that have been devised for the purpose of keeping down tax levies and limiting the amount of public debts. These methods have been more or less ineffective, especially in keeping down tax levies. Why have certain methods failed to attain the desired goal of economy and efficiency in public administration? Is it possible in the nature of the case to put the levy of taxes and the floating of public debts on what may be termed a business basis? A working plan that will accomplish such a result is very much worth while and would be welcomed by taxpayers. The attainment of the desired end seems as remote as it ever was.

Tax Limitations.—A very common practice in a number of states is to limit arbitrarily the local tax levy that may be made for a certain purpose definitely prescribed by statute. The same is true of the amount of indebtedness that may be incurred by a given local unit of government. This method has failed to serve as a real check on tax levies and the floating of bonds. As a general rule, statutes of this nature are loosely drawn, and are subject to constant amendment at the urgent request of public officials. In Iowa, for a number of years, it was the common practice of county boards of supervisors to issue "stamped" warrants in payment for certain highway improvements. Under certain conditions it was possible to issue bonds to take up these warrants. This practice has recently been discontinued, but in the meantime a large part of the local highway bonded debt in the state of Iowa is traceable to the unbusinesslike practice of issuing warrants when there were no funds with which to pay them, and later converting the obligation into a bonded indebtedness.

The policy of limiting tax levies has produced results equally unsatisfactory. States like Minnesota and Ohio have made

[1] U. S. Department of Agriculture, Office of Public Roads and Rural Engineering, *Bull.* 136, "Highway Bonds," 1917.

special efforts along this line, with results that cannot be regarded as successful.[1]

There are two very common devices for evading tax and public-debt limitations. The first device is that of constantly amending the tax laws, frequently in such a way as to apply to only one or two cities. The portion of the Code of Iowa, 1924, dealing with cities and towns, contains a very large number of what are in reality special statutes having for their purpose the increase of normal tax levies or the making of additional levies for new purposes. Municipal officials have become experts in securing this type of legislation. The second device is the legalizing act. Local spending bodies contract heavier debts for various purposes than the law permits and then secure a special legislative enactment to legalize the indebtedness. There is no record of a request for a legalizing act of this kind having been denied. The control of bond issues and tax levies by general legislation has not proved effective.

Popular Control.—A second and very common plan of controlling public debts is to have bond issues approved in advance by a vote of the people. The theory is that if the public at large is willing to pay for a certain improvement, no one can deny the right of the taxpayer to incur indebtedness to make possible the improvements desired. The theory appears to be sound and is frequently advocated or tacitly accepted by politicians. This is a very important phase of public finance and one deserving of a more painstaking and scientific study than it has received in most states. The matter cannot be dismissed with a wave of the hand on the theory that the people rule, for whatever may nominally be true, every observing person knows that in a great many of such cases the people do not rule. The simple truth is that the public at large is apparently not enough interested to inform itself along these lines. Some of the problems involved, moreover, are of a technical character and could not be understood by the average voter when he is called on to pass judgment at the polls.

In this connection two cases very much to the point may be mentioned. How many citizens always make it a practice to attend elections where bonds are to be voted to build schools or other capital improvements of a public character? Only a very small percentage of voters take the trouble to go to the polls, as a general rule.

[1] "State and Local Taxation," pp. 41–61, 1922.

A second example developed in Indiana. Practically all of the taxpayers in a certain locality in that state thought they were in favor of a given road improvement. Sentiment along that line had been worked up in the usual way. A handful of taxpayers objected and appealed to the State Budget Board. A member of that body went to the locality and held a meeting of the taxpayers, a large majority of whom were indignant to think that anyone had objected to the improvement. After the real facts had been explained and the proposal divested of all selfish propaganda, the meeting voted unanimously against the improvement. Examples showing essentially the same situation are found in almost every community. Needless to say, the people who pay the taxes should control their own tax levies and bond issues. This is the very essence of democratic government. There is reason, however, to doubt the efficacy of the control of bond issues by direct vote of the people either at a general or special election unless in the meantime provision has been made by law whereby the facts will be submitted to the voters by a competent administrative board with the necessary experienced technical staff.

Administration.—A third method of controlling bond issues for road improvement or other similar public purposes has been suggested. A strictly modern state highway commission with its staff of engineers and other trained specialists is in a position to know much better than the general public when it is wise to float a bond issue. The American Association of State Highway Officials, for example, has given a great deal of study to this and closely allied highway problems. It should be observed that commissions of this nature will be able to render efficient service to the extent that they are divorced from the exigencies of party politics. Not only have a number of state highway commissions accomplished excellent results in this field, but there has been a tendency of late to provide state and local budget supervision of bond issues and public expenditures generally. More and more attention is being given the subject of public expenditures, which is quite as important as that of public revenue.

In this connection mention should be made of the state supervision of local bond issues in Indiana and Iowa, on appeal from interested citizens. The Indiana law also provides for supervision of local tax levies on appeal. Millions of dollars of the taxpayers' money have been saved in Indiana during the last few

years by the State Tax Commission acting as a Budget Board on appeals in the matter of local tax levies and bond issues. The experience of Indiana and the somewhat more limited experience of Iowa are worthy of study by those who are endeavoring to find practical methods for a more efficient control of public finance in general or highway finance in particular. A necessary part of true local self-government is to give the local taxpayer, subject to proper limitation and restriction, the right of appeal to an impartial tribunal in cases where his own local officials have failed to perform their duties in the manner provided by law, or to exercise reasonably good business judgment. Local self-government, which is the product of more than a thousand years of history, does not exist wholly or even primarily for the benefit of local officials, but rather for the protection of the individual who may have no desire to hold office, but does bear his proper share of the financial burdens of government.

CHAPTER IX

SPECIAL ASSESSMENTS

The term "special assessment" is used with various meanings by writers on taxation, and is employed in several different ways in tax laws. While in every case where the term is used there is a certain similarity in the significance of the application, there does not seem to be an exact and generally accepted definition for the term, nor are all of the imposts that are called special assessments entirely alike in character.

This discussion will be limited to that method of financing highway and street improvements which is based on a distribution of all, or part of, the cost to the land in an area in which it is assumed that special benefits accrue because of the improvement of the roads or streets. The process of allocating the costs to the several parcels of land is one of determining the relative benefits for each tract, and hence the term "special assessment" is used in its most rigid and limited application herein.

Special assessments represent a general form of public revenue coordinate with revenue from the public domain, public industries, fees, and taxes. In common with fees and taxes, special assessments are now almost universally levied under the taxing power of the state, although in certain cases they have been imposed under the police power and also under the power of eminent domain. Special assessments assume considerable financial importance in the construction of public highways, especially within the boundaries of towns and cities, and are distinguished from taxes by important differences of a legal and economic character.

ORIGIN AND DEVELOPMENT

England. The form of financing that is now called special assessment has been traced back to 1427, at which time a number of acts were passed in England creating commissions charged with the construction and repair of walks, ditches, gutters, sewers,

bridge causeways, and trenches which had been impaired by the inundation of the sea. The cost of this work was apportioned among the landowners who received benefits. During the reign of Henry VIII, legislation of a similar character was passed, including a provision requiring that notice of assessment be given the landowner.[1]

The great fire in London in 1666 necessitated the rebuilding of a considerable part of the city. In order to carry on that work in a systematic way, comprehensive legislation was adopted in 1667, which appears to have been the model for our first colonial laws dealing with this subject. Indeed, a part of the law of the province of New York, 1691, follows the English law of 1667 almost word for word.[2] Under the Act of 1667, the corporation of London was empowered to appoint certain persons with authority to pave the streets and to make other municipal improvements, and impose any reasonable tax upon all houses within the city in proportion to the benefits received.

During the progress of rebuilding the city of London following the great fire, it seems that special-assessment districts were created with much care on the theory of benefits received instead of regarding the entire city as a unit. With this legislation, which was supplemented by a carefully thought-out plan of administration, it is evident that the foundations were laid for the modern system of special assessments.

France, Belgium, Prussia. The principal of special assessments may be traced back to 1672 in France, 1807 in Belgium, and 1875 in Prussia. The French law of 1807 provides that when the opening of new streets causes an advancement in the value of private property, said property may be charged with the payment of an indemnity equal to half the value of the benefits received. It seems that very little advantage has been taken of this statute in France, while in Belgium the principle of special assessment is recognized more generally than is the case elsewhere in Europe.[3]

New York.—Special assessments in the United States date back to the provincial law of New York, 1691. An act for regulating the building of streets, lanes, wharfs, docks, and alleys in the city of New York contains the following provision:

[1] "Henry VI," Chap. V (1427), and 23 "Henry VIII," Chap. V (1531).

[2] Fairlie, "Municipal Administration," p. 357.

[3] Rosewater, Special Assessments, in "Columbia University Studies in History, Economics, and Public Law," vol. 2, 3, pp. 9–21.

And for the better effecting whereof, it shall and may be lawful to and for the said Mayor, Aldermen and Common Council, together with the said Surveyors and Supervisors, at their said Meeting, to impose any reasonable Tax upon all Houses within the said City, in proportion to the benefit they shall receive thereby, for and towards the making, cutting, altering, enlarging, amending, cleansing and scouring all and singular the said Vaults, Drains, Shoars, Pavements and Pitching aforesaid. And in default of payment of the said sum to be charged, it shall and may be lawful to and for the Mayor, Alderman, Etc., so authorized, as aforesaid, by Order of Warrant under their Hands and Seals, to levy the said sum and sums of Money, so assessed, by distress and sale of the Goods of the Parties chargeable therewith, and refusing and neglecting to pay the same, rendering the Over-plus, if any be.[1]

Following the Revolutionary War, a new law was enacted (1787) which differs from the law of 1691 in several particulars. Perhaps the most essential difference is the fact that only a general theory of benefits is outlined in the statute, the mayor and aldermen being given a wide discretion as to the method of fixing the assessment of benefits. That provision of law is as follows:

And for the better effecting thereof, it shall and may be lawful to and for the mayor, aldermen and commonalty of the said city in common council convened, to cause to be made an estimate, or estimates, of the expence of conforming to such regulations aforesaid, and a just and equitable assessment thereof among the owners or occupants of all the houses and lots intended to be benefited thereby in proportion, as nearly as may be, to the advantage which each may be deemed to acquire respectively. And in order that the same may be safely and impartially performed, the said common council shall, from time to time, appoint five sufficient and disinterested freeholders for every such purpose, who, before they enter into the execution of their trust, shall be duly sworn before the said mayor or recorder, to make the said estimate and assessment fairly and impartially, according to the best of their skill and judgment; and a certificate in writing of such estimate and assessment being returned to said common council and ratified by them, shall be binding and conclusive upon the owners and occupants of such lots so to be assessed respectively; and such owners or occupants respectively shall thereupon become and be liable and chargeable, and are hereby required to pay such person as shall be authorized by the said common council to receive the same, the sum at which such house or lot shall be so assessed.[2]

[1] *Ibid.*, pp. 22–23.
[2] *Ibid.*, p. 24.

The mayor and aldermen were somewhat reluctant to exercise the large general powers granted them under the statute, although from time to time the legislature, on request, reaffirmed and to some extent expanded this general authority. By 1813 the plan of taxation by special assessment had developed to the point where the legislature authorized its application to Albany, Hudson, and Schenectady, as well as New York. The distinction between special assessments and ordinary taxes had been formally recognized by the New York courts at least as early as 1813.

By 1851, after considerable litigation, the legal and constitutional status of special assessments was finally settled, it being held that assessments of this character are levied under the taxing power of the state and are not therefore limited to the police power or that of eminent domain. Legislation in New York following 1851 distributed the power of making special assessment among various municipal authorities, and finally provided a legal remedy for the taxpayer in case of fraud or error.

Summary.—The practice of levying special assessments for certain public improvements of direct benefit to abutting and adjacent property, which had originated in England, was transplanted to the province of New York in 1691. Its application developed first in the city of New York and later in other parts of New York State, and then spread very rapidly through the country at large. By the year 1893, forty of the then forty-four states and two territories had accepted the doctrine of special assessments.[1]

Legal and Constitutional Status.—While special assessments are generally levied under the taxing power of the state, there are a number of legal distinctions which should be drawn between ordinary taxes and special assessments for certain improvements that confer local benefits.

Personal property is not subject to special assessment for local improvements for the reason that it cannot be specially benefited by the improvement.[2] Exemption from taxation in general or from county taxes (such as is granted to Civil War and World War veterans, for example) does not exempt from special assessment for public improvements.[3] Constitutional and

[1] *Ibid.*, p. 52.

[2] COOLEY, "The Law of Taxation," vol. 2, p. 1234.

[3] *Ibid.*, p. 1446.

legislative tax limitations do not apply to special assessments.[1] In construing the meaning of acts of exemption from all state, county, municipal, local, and special taxation, it has been held by the courts that the term "special" does not apply to special assessments for road or street improvements, but only to special tax levies for roads, bridges, schools, and parks that are made in the same manner as general taxes. Finally, clauses in state constitutions relating to equality and uniformity of taxation do not apply to special assessments.

The differences between a special assessment and a tax are that (1) a special assessment can be levied only on land; (2) a special assessment cannot (at least in most states) be made a personal liability of the person assessed; (3) a special assessment is based wholly on benefits; and (4) a special assessment is exceptional both as to time and locality.[2]

LEGAL BASIS OF SPECIAL ASSESSMENT

There are three distinct powers of the state under which special assessments may be levied: police, eminent domain, and taxation.

Police Power. —The police power of the state and its political subdivisions is very extensive and elastic and at a very early date was employed as a justification for special assessments, especially in cases involving regulations to promote public safety or to protect the public health. The police power may be employed to abate a nuisance, whether it be in the form of a dangerous sidewalk, or an offensive lot which ought to be drained or cleaned.

There are many court decisions upholding the right of a municipality to order the construction of a sidewalk, and if the same is not constructed within a certain definite time specified in the order, to cause the walk to be built and the cost charged to the property owner. This is a clear case of police regulation, and on that basis has been supported by the courts with but little difference of opinion.

In cases of this nature the doctrine of benefits received does not necessarily apply, the actual cost at times being in excess of the direct benefit to the lot owner. It has been held competent to order a sidewalk constructed on one side of the street and not make the same requirement for the other side. In this respect special assessments levied under the police power are quite different from those authorized under the taxing power of the state.

[1] *Ibid.*, vol. I, p. 348.

[2] *Ibid.*, pp. 106–107.

Sewer assessments, being the outcome of a sanitary or health regulation, can clearly be included under the police power. The same holds true of assessments for the construction of levees to protect tracts of land from overflow and possible property damage. Similar considerations apply in the case of drainage laws which are enacted for the double purpose of reclaiming land and as a public health regulation.

The construction of sidewalks, sewers, levees, and drainage works also may be financed out of general or special tax levies. Special assessments represent only one form of revenue which may be employed for such purposes.

Eminent Domain.—Special assessments, at a very early period, were associated with the power of eminent domain. By eminent domain is meant the right of the state to appropriate for its sovereign purposes the property of a private individual on condition of the payment of a just compensation. Private property also may be appropriated under the power of taxation but in a very different manner. In the application of eminent domain a particular item or parcel of property is taken for a distinct public purpose on payment of a fair consideration. The people as a whole are called upon for equitable proportional contributions of taxes (which means contribution of property) on the theory that the general burdens of government should be borne by all on some uniform and equitable basis, and not because of special benefits. While the obligation to pay a compensation for property appropriated for public use is fundamental to the operation of eminent domain, no such limitation is imposed upon the taxing power of the state.

The opening up of new streets and the widening of old ones, frequently necessitating the destruction of valuable buildings, requires the taking of private property for public purposes. Under the right of eminent domain this can be done by paying the proper compensation. At an early date it became apparent that the opening of new streets and the widening of old ones increased the value of abutting and adjacent property, thus serving to compensate at least in part for the assessments for the improvement. It appears that when King Street was laid out from Guild Hall to Cheapside, London, in 1667, the owner of a piece of land, part of which was taken, asked 200 pounds damages. In view of the fact that enough ground was left on each side of the street to permit the erection of buildings, the court allowed the city a

counter claim, with the result that the owner gladly ceded his land in exchange for the benefits received from the laying out of the street.[1]

Strictly speaking, the power of eminent domain does not go beyond the granting of just compensation for damages done, yet it is possible to push the doctrine far enough to support a compulsory contribution in the form of special assessments when the benefits conferred equal or exceed the value of the property taken in connection with a given improvement.

It would be very difficult to justify the millions of dollars that have been expended in recent years for the improvement of public highways, either as a police measure or by any application of the right of eminent domain. No problem of public health, morals, or safety is involved, and ordinarily, no private property is taken to make possible the highway improvement.

In those instances where roads are straightened or relocated the power of eminent domain might be invoked to secure needed right of way, but these cases are the exception rather than the rule at the present time.

Taxing Power.—The third phase of the legal theory is the authorization of special assessments under the general taxing power of the state. While special assessments are not taxes in the ordinary meaning of the term, they do partake of the nature of taxes. The levying of taxes and special assessments is an exercise of the taxing power of the state, as is the levying of fees. The payment of taxes and of special assessments is compulsory, and both are employed to secure funds for public purposes. After a long line of conflicting judicial opinions, the question of the legal status of special assessments was finally put at rest in 1851 in a very comprehensive opinion by Judge Ruggles of New York.[2]

General Applications.—It would be a mistake to assume, as some apparently have done, that under all conditions and circumstances the taxing power of the state and its subdivisions supplies an ample legal basis for levying special assessments. Under the police power, special assessments may be levied in excess of the benefits conferred by a given improvement. This cannot be done under the power of taxation. Improvements

[1] Ormond, "Assessments for Local Improvements" in Proc. of Society of Municipal Engineers of the City of New York, p. 207, 1914.

[2] People *vs.* Mayor of Brooklyn, 4, New York, pp. 424–439.

which involve special assessments frequently require the taking of private property for public purposes under the power of eminent domain. Damages apportioned under the power of eminent domain and benefits apportioned to the same property owners are often entailed by an improvement project, and the administration of the two functions should be vested in the same board or commission. Special assessments as now employed for financing public improvements are so extensive in scope and complex in character that the police power, eminent domain, and the power of taxation are all involved in many of the problems that arise in the application of this method of financing.

FISCAL STATUS OF SPECIAL ASSESSMENTS

In presenting the legal and constitutional basis of special assessments, something necessarily has been said of the financial aspects. It is not always possible to draw distinct lines between legal and fiscal considerations in the application of this method of financing.

Special assessments authorized under the taxing power must not exceed benefits received, in the almost universal opinion of the courts. If, then, special assessments are compensated for by the increased value of the property benefited, there is no tax in the ordinary sense of that term. This explains why special assessments are not subject to ordinary tax limitations or to the equality and uniformity of taxation provisions of the state institutions. The United States Census Bureau defines special assessments as "compulsory contributions levied to defray the costs of specific public improvements or public services undertaken primarily in the interest of the public."[1]

Special assessments differ from the general property tax in that they are apportioned according to the assumed benefits to the property affected by the improvement, or the assumed benefits to individuals or corporations by reason of the services performed. This definition is in substantial conformity with the idea of leading publicists in the field of taxation. Cooley refers to special assessments as in the nature of a tax upon property, levied according to benefits conferred on said property. Professor Seligman[2] brings out the same three essential points

[1] Department of Commerce, Bureau of the Census, Wealth, Public Debt, and Taxation, "Taxes Collected," p. 2, 1922.

[2] SELIGMAN, "Essays in Taxation," 9th ed., pp. 415–20, 1921.

in his definition: first, compulsory contribution, second, special benefits received by the owner of abutting or adjacent property; and third, the public interest.

Rosewater has written an excellent discussion of the relation between special assessments, special taxes, general taxes and fees, in which the same general conception of special assessments is presented.[1]

Theory of Special Benefits.—The doctrine of special benefits is considered to be fundamental to the levying of a special assessment for road or street improvements. To what extent is it possible or practicable to draw fine distinctions and say that some benefits of certain road improvements accrue to a limited area as special benefits, while to others as general? Probably there are few instances where the special and general benefits can be separately appraised. If it were true that both general and special taxes are apportioned on the basis of faculty, or ability to pay, and without any reference to benefits received, it would follow logically that special assessments would differ even from special taxes in that the former were based on special benefits received and the latter on faculty or ability to pay. Such conclusions do not conform to the hard facts of the case. There are usually general benefits that accrue because of highway improvements that are paid for wholly by special assessments on property and quite often very special benefits accrue to some property because of road improvements that are paid for out of general or special tax receipts.

Under the present procedure there are but few distinctions that can be drawn between special assessments and certain special taxes, so far as special benefits are concerned. The two merge into each other and even overlap. Special taxes shade into special assessments in a very unobtrusive manner, the transition being at times almost imperceptible.

Special Taxes.—The tax levies for all the taxing districts in Story County, Iowa, for the year 1922 included 1 mill for county drainage, a bridge levy, and two road levies, one being specifically for road building purposes. There are at least three township levies, one for roads, a second for dragging roads, and a third for township road drainage. Among the items for which there are levies for municipal taxes are the following: sewage disposal,

[1] ROSEWATER, Special Assessments, in "Columbia University Studies in History, Economics, and Public Law," vol. 2, 3, pp. 128–132.

garbage disposal, county bridge, park, grading, water-works, light, sewer, and drainage. These are in the main what might be called special taxes as contrasted with general taxes for the more general functions of the municipality such as police, fire protection, and clerical. To what extent might some of these improvements be financed through special assessments rather than through special taxes? Certainly some of them might be financed partly through special assessments.

The greater number of special-assessment projects are of the class known as street improvements. This includes the widening and straightening of old streets; the opening of new streets; grading, leveling, and draining of streets; the construction of sidewalks, curb, and gutter; and the beautifying of streets by shade trees or parks, the sprinkling of them by day, and the lighting by night. Special assessments are levied to pay for the construction of sanitary sewers, the removal of obstructions in waterways and for the construction of embankments and piers and for the acquisition of public parks and squares. Special assessments frequently have been employed to defray the cost of pipes or wires that must be constructed in connection with municipally owned public service monopolies. Sanitary improvements, such as levees and the drainage of swamps, have been mentioned in connection with the levying of special assessments under the police power. Other examples might be given, as the list of objects for which special assessments have been levied under different jurisdictions, is a very extensive one.

It is apparent that many kinds of improvements for which special assessments have been authorized also may be financed through special taxes. Whether one or the other method of finance is employed is largely a matter of indifference from the standpoint of fiscal theory. The doctrine of special benefits is frequently less important than other considerations. If the tax limit or the debt limit has been reached in a municipality and certain local improvements are desired, special assessments are a possible and, when properly administered, a very just and equitable method of finance. It seems obvious that certain special taxes are based upon the doctrine of special benefits, almost to the same extent as special assessments. In fact, the theory of special benefits is primarily a legal doctrine which is not based on a very critical analysis of the economic facts involved, but affords a convenient method of financing certain classes of public improvements.

Tax and Debt Limitations.—Many public administrative bodies find it necessary or desirable at times to circumvent the various constitutional provisions relating to tax and debt limitations and of equality and uniformity of taxation. The courts have conveniently provided a solution to the difficulty by holding that a special assessment is not in reality a tax under the meaning and intent of the constitution, but is a compulsory contribution, which is returned again to the taxpayer in the form of increased value to his property. There has perhaps been somewhat too much of a tendency for publicists to accept legal theory as the equivalent of careful economic analysis. The situation thus created, nevertheless, has facilitated the improvements of municipal highways and is accepted as a means to a much-desired end.

Assessment Districts.—If the doctrine of special benefits does not warrant or justify an economic distinction between special assessments and special taxes, what then is the real difference from a fiscal and economic standpoint between these two forms of compulsory contribution? Is there a distinction aside from the legal formulas already noted? So far as special assessments are applied in the highway field, the assessment district almost never coincides with the boundary lines of a county, township, municipality, or other political subdivision. In rare instances it may do so. This is one real difference between a special assessment district and a district in which special taxes are levied, which usually is a whole political subdivision, although in rare instances it is not.

Thus, the more elastic boundaries of a special assessment district make it possible to provide a more just and equitable assessment, measured by benefits received, than would be possible by following the fixed boundaries of a political subdivision.

General Benefits. It will be recalled that the definition of special assessment involves three essential elements: compulsory contribution, special benefits received, and the public interest, or a definite public purpose. The obvious antagonism which exists between a rigid adherence to the doctrine of special benefits on the one hand, and of the public interest on the other, has quite generally escaped the attention of publicists but not of practical administrators. How can a given improvement be in the public interest or for a definite public purpose and not confer a public benefit as well as a special benefit? To the extent that an improvement does confer a general public benfit, it should be

financed through special, or possibly even through general, taxes instead of placing the entire burden on the shoulders of the owners of abutting and adjacent property. For this reason the entire cost of a given highway or street improvement is not always charged to the owners of abutting and adjacent property in the form of special assessments and probably rarely should be so assessed.

Application to Highways.—A well-improved public highway consists of four essential parts: the right-of-way, the bridges and culverts, the roadbed, including provision for drainage, and the roadway surface of gravel, concrete, asphalt, brick, or some similar material.

Such an improvement confers different degrees of special benefits which merge into general benefits, requiring for complete equity a complex method of finance, which should include general taxes, special taxes, and limited special assessments in the rural districts, and an extensive special assessment within the boundaries of incorporated towns and cities. Under existing statutes, the financing of improvements to streets or highways rarely can be just, but the trend of practice and of legislation is toward greater equity in the distribution of the costs of these improvements.

Proportionality.—It is the recognized principle in American jurisprudence[1] that special assessments must be proportional to benefits. This is the first consideration in the practical problem of levying assessments for specific improvements, but assessing boards are given considerable discretion with reference to the determination of the magnitude and distribution of special benefits resulting from street or highway improvements. A few generally accepted principles serve as the basis for most assessments. One is that two parcels of land of equal size and similarly located with reference to an improvement are probably equally benefited. The converse is that unequal tracts similarly located are probably not equally benefited, but on the contrary the larger tract has received a greater benefit than the smaller.

Faculty.—In estimating the amount of benefit that has accrued as a result of a public improvement, no consideration is given to the value of the benefited property. That is, there is no relation between *benefits* and *ability* to pay. *Assessments*, on the contrary, are often fixed by ability to pay. The benefit to a parcel of land might be assessed at so large a sum that the

[1] SELIGMAN, "Essays in Taxation," 9th ed., p. 416, 1921.

owner would not pay, preferring to relinquish the land. To prevent injustice in this way, the total that may be assessed is limited by statute to some per cent of the value of the land assessed, usually less than 50 per cent. In this respect, the assessment is based on ability to pay as well as on benefits.

Progressivity.—It seems to be accepted by engineers, administrators, and the courts that the benefits accruing to property from highway improvements diminish rapidly as the distance from the road or street to the benefited property increases. This is sometimes referred to as the principle of diminishing benefits.

The rate of diminishing benefit has been the subject of many discussions, but there is really little tangible evidence upon which to base a theory as to the proper rate. That the rate should decrease as some power of the distance seems to be accepted, and most experts agree that the power should be greater than unity. Assessments based on the theory that the benefits diminish as the square of the distance from the improvement have been used extensively and, in some instances, the cube of the distance has been adopted as the rate. There is considerable latitude allowable in this connection and each assessment problem must be solved on the basis of the equities in that particular case.

When the benefits are assessed in accordance with the principle of diminishing benefits, the assessment is said to be progressive, which means that it varies according to some systematic scheme, the greater benefit to the parcels of land near the improvement being recognized in the assessment.

The principle of progressivity is the rule followed not only by administrators, but also by the courts, rather than the exception, as it is with both general and special taxes. The special assessment formulas outlined by expert boards and commissions in conformity with law and approved by the courts apply the principle of progressivity to an unusual extent in measuring the benefits received and in apportioning the costs of a given local improvement. Progressivity is the rule and not the exception in apportioning special assessments. It is, in fact, of the very essence of such assessments. The principle not only can be applied, but is applied much more completely and with a larger measure of social justice than is the case with any other form of taxation.

Betterment Tax.—In Massachusetts there is what is known as a betterment tax which takes the place of special assessments, but the words "special assessments" and "betterments" are

synonymous, and used to designate special taxes based upon special benefits derived from the construction of public improvements. When levied, the owner has the privilege of paying in a lump sum or in yearly instalments over a 10-year period.

Capital Account.– Special assessments are generally levied for improvements that are of sufficient permanence that they increase the capital account of a given community, instead of for the maintenance or operation of existing improvements. In the municipal field there is some tendency to use special assessments for financing the repair or reconstruction of pavements and this policy is economically unsound but exceedingly convenient and, therefore, probably will continue to be followed.

In constructing various local improvements, debts are quite commonly incurred for a short period of years and the revenue obtained from special assessments is used to amortize these debts in exactly the same way that revenue from ordinary taxation might be used to amortize debts incurred for the same character of improvements. Public revenue, the same as private revenue, is used to pay for economic goods, which may take the form either of economic services (*i.e.*, pavement maintenance) or of different classes of tangible wealth (*i.e.*, pavements), the latter frequently representing a capital account. Revenue from ordinary taxation may be used for any of these purposes and is widely used to build and maintain public highways, parks, and similar local improvements, and the same is true of revenue from special assessments. No very rigid lines can be drawn between the two forms of public revenue from the point of view of capital account as contrasted with income account, nor is there a need for doing so.

Summary of Fiscal Status. Concluding this survey of the fiscal status of special assessments, it is evident that the police power, the right of eminent domain, and the power of taxation are all involved in the various ramifications of this important form of public revenue. The taxing power is the all-important consideration, but the opening up of new streets, or new highways, and the widening of streets or highways, involve the taking of private property for public use under the right of eminent domain. While the police power is relatively much less frequently invoked than it was a half-century or a century ago, it still may be employed in connection with special assessments when the public health, public safety, or public morals are involved.

A critical analysis of the financial policies of European cities would no doubt explain why special assessments, as employed in the United States, have been used so little, except possibly in Belgium. Wagner, in his great work, "Finanzwissenschaft," devotes about four pages to the subject of special assessments.[1] He does little more than recognize special assessments along with fees and taxes. A leading Italian writer, Graziani, also mentions special assessments, but does not enter into any detailed discussion of this form of public revenue.[2] From such limited evidence as is obtainable, it appears that in Europe local improvements are financed through special taxes which are not very different from the special taxes so often levied in the United States and which closely resemble special assessments.

APPORTIONMENT OF SPECIAL ASSESSMENTS

A number of general economic and administrative principles are involved in the apportionment of special assessments on the theory of special benefits having resulted from a given capital improvement. Reference frequently has been made in the preceding pages to the theory of special benefits and to the fact that when public improvement are financed through special assessments, costs to each parcel of land should be apportioned, as far as possible, in accordance with said benefits.

It is much easier to specify that the cost of an improvement is to be assessed according to benefits than it is actually to spread an assessment in strict conformity with that principle. No single rule can be formulated that will fit all cases and no two assessments can be spread in exactly the same way. There are a few mathematical processes that have been widely used in connection with assessments and these or some combination of them will serve to enable the assessor to distribute the cost in a logical and equitable manner, and he can then study the resulting rates in the light of the exact situation with reference to benefits to each parcel of land that is assessed, and thus arrive at a final assessment that is fair and just.

Extent of Benefits.—The lateral distance to which the benefits extend when a street is improved is problematical, but, fortunately for the assessor, this question is generally settled by statute. For ordinary street improvements such as paving or

[1] WAGNER, "Finanzwissenschaft, Zweiter Theil," pp. 189–192, 1890.

[2] GRAZIANI, "Istituzioni di Scienza Delle Finanze," 2d ed., p. 193, 1911.

curbing, the statutes generally provide that the benefited area to be assessed may not extend more than half-way to the next parallel street. This is sometimes limited still further by providing that if two parallel streets lie at some distance apart the assessment may not extend more than some statutory distance, say 300 feet, from the improved street.

Assessed Value.—Apportionment of assessments should take some account of the value of the property assessed. Needless to say, this is a very important consideration if assessments are to be spread with a reasonable degree of justice. The value at which property is assessed for general taxation is often very far from true value and is of little use in this connection. The really important thing is not the present value, however determined, but rather the value including that increment resulting from a given improvement. The problem really resolves itself into determining whether the parcel of land under consideration is of such a nature that it will respond to the effect of the improvement by increasing in value, or will in fact be benefited. It is very seldom that road or street improvements fail to increase the value of the assessed land, but the influence of the improvement may not manifest itself for several years after the improvement is completed.

A street along which were small shops and dwellings of the "flat" type was widened to form an arterial way some miles in length. For some months after the street work had been completed, the buildings presented a most forlorn appearance. The front portion of the buildings had been cut away to secure the added width of street and many of them were gaping openings as though the buildings had been sliced with some giant and none-too-sharp shears. In a few years, however, smart shops, automobile show rooms, and other similar commercial enterprises had taken over the premises, and new and improved building fronts had converted the street into a most imposing thoroughfare. There could be no doubt that a benefit had accrued to the property, but it required several years for the situation to work out.

METHODS OF ASSESSMENT

Within the zone of benefits prescribed by statute, or established by the assessor in conformity with the statutes, the assessor must distribute the assessment in a manner that is equitable and

uniform and at the same time insure that the total of the assessment is equal to the part of the cost of the improvement that is to be paid by the property owners through these special assessments. The portion of the cost that is assumed to represent general benefits is met by some general or special tax.[1]

If an assessment district is of any considerable magnitude and consists of numerous parcels of land of various shapes and sizes, some mathematical system of distribution of benefits is indispensable. Otherwise, it will be impossible ever to complete an assessment in an equitable manner. There are several methods of performing the required calculations, and the particular one that is to be used will depend upon statutory limitations and the nature of the assessment district. Generally speaking, four factors are considered in estimating the benefit to a parcel of land; area, topography, the proximity to the improvement, and the actual value of the land. Of these the third is usually left out of consideration while a tentative assessment is being made, and the tentative assessment is then modified to relieve parcels of low value if any such exist.

The following methods of distributing the assumed benefits are employed by various departments and sometimes a combination of them seems to be preferable to any one. These methods should be considered merely as guides and are not to be applied rigorously unless the conditions justify doing so. Generally, some one of these will be entirely fair and readily applicable.

Front-foot Rule.—When assessments are spread to cover the cost of street paving, curbing, or sidewalks, it is the rule of many cities to consider that the benefits to any parcel of land vary according to the length of frontage of the parcel on the street that is improved. Where building lots are laid out at right angles to the street and all extend back about the same distance, this method is equitable and is quite easily applied. No account can be taken of possible benefits to parcels of land adjacent to the improvement but not abutting thereon ("back lots"), and in many cities the statutes do not permit assessment of adjacent parcels of land. The front-foot rule is difficult to apply to tracts of irregular shape and should not be used for them.

This method of assessment is not adapted to projects that include the widening of streets into boulevards or arterial ways,

[1] For more detailed discussion see, "Construction of Roads and Pavements," McGraw-Hill Book Company, Inc., New York.

nor to projects involving the opening of new streets. The zone method or the benefit-factor method usually will be more satisfactory for these cases.

The front-foot rule will fail to distribute the benefits equitably in a residential district where diagonal streets form triangular or trapezoidal parcels with a high ratio of frontage to area. In a business district, the large proportion of frontage may be an asset, and an assessment by the front-foot rule may be entirely equitable.

The front-foot rule is seldom used for suburban and rural highway projects, and probably never should be employed in those cases.

Area Rule.—It is seldom that assessments for municipal pavements are based wholly on benefits allocated in accordance with the area of the several parcels of land in the benefit district, but some districts are composed of plots of such dimensions that the benefits do vary substantially as the areas of the respective parcels of land in the district. If the portion of the city involved is laid out in lots of equal frontage and the depths of the lots vary, the area method of distributing benefits is equitable. The lots abutting intersecting streets may be shorter than those in the anterior of the block, through the rear portion having been disposed of to form a new lot fronting on the intersecting street. While area should be taken into account in determining benefits, of itself it is suitable as the sole basis for assessment in only a small proportion of the districts met with in practice.

Zone-and-area Method.—In order to take into account the diminishing benefits on the parcels of land that do not abut on the improvement, and to recognize the variation of benefits with area, the zone method of distributing benefits is employed both for municipal street improvements and for rural and suburban roads. The whole area of the benefited district, the extent of which is generally specified by statute, is divided into zones parallel to the improvement, and to each zone is assigned a predetermined percentage of the total sum to be assessed.

Considerable latitude is allowable in the width of zone, and the assessor fixes that according to his best judgment. In city practice it is customary to make each zone correspond to the prevailing depth of the lots, although this is not vital. In rural highway assessments, the zones are usually fractions of a mile in width. If the assessable width were 1 mile on each side of the improved road, the zones might be ¼ mile wide, or even ½ mile wide.

The percentage of the total to be assessed on each zone is based on the assessor's judgment as to the rate at which the benefits diminish on lands at various distances from the improvement. Generally, it is assumed that the benefits diminish as the square or the cube of the distance, but here, again, considerable latitude is given the assessor, who is expected to follow a rule that is equitable for the particular problem upon which he is engaged.

Benefit-factor Method.—To indicate the rate of diminishing benefits on the parcels of land more remote from the improvement, a curve is sometimes drawn to indicate in units of arbitrary value the amount of benefit to a parcel of land lying anywhere in the benefit district. If a benefit district on one side of a street has a width of 200 feet and on the other side a width of 250 feet, it is apparent that any lot that extends from the street to the limit of the district on the 250-foot side would receive greater benefit than one extending to the limit on the 200-foot side, because the longer lot contains more area per foot of frontage; but if the law of diminishing benefits is recognized, the additional benefit to the longer lot is not directly proportional to the excess in length. To arrive at some measure of the added benefit to the longer lot, it is first necessary to determine the law of diminishing benefits, or to assume a law that seems to be fair.

Let it be assumed that the assessor concludes that the benefits diminish as the square of the distance from the improvement, beginning at the property line of the street that is improved. For convenience, it is further assumed that the longest lot in the district receives 100 units of benefit per foot of frontage. (This might be 1 unit or 1,000 units if preferred, without invalidating the method.) In the example cited above, the maximum rate of benefit would accrue to a lot having a length of 250 feet. A curve is drawn to such a scale that the abscissæ represent feet and the ordinates units of benefit. One point on the curve is determined by the fact that a lot 250 feet long receives 100 units of benefit per foot of frontage. Another point is determined by the fact that the benefits are assumed to diminish as the square of the distance from the improvement; therefore, a lot extending 125 feet back from the street would receive 75 units of benefit per foot of frontage. In this way the units of benefit per foot of frontage accruing to a lot of any length can be computed and the curve is fully determined. Obviously, the number of units of benefit can be calculated by multiplying the number of units of benefit per

foot of frontage shown by the curve, by the width (frontage) of the lot in feet. When this has been done for every parcel of land in the benefited district and all added together, a grand total of the units of benefit to the whole district has been obtained.

The cost of the improvement per unit of benefit is then obtained by dividing the total cost by the total number of units of benefit. The assessment for each parcel is obtained by multiplying the number of units of benefit accruing to that parcel by the cost per unit.

It should be apparent that an assessment which is spread in this way takes account of the area of each parcel of land, the frontage of each parcel, and of the theory of diminishing benefits. The method is applicable to a wide variety of assessment district conditions and to various types of improvement. It may be used wherever the zone method would be suitable and is more flexible than the zone system. It can be used to distribute the benefits resulting from the construction of arterial highways, boulevards, parks, playgrounds or any other capital improvement assessable by the benefit method.

Combined Systems.—The several systems of spreading assessments that have been described in the preceding sections may be used alone, but they are more often used in combinations. Areas and frontage are often considered together, and zone and area assessments are very common. In recent years there has been a great deal of investigation of the effectiveness of various systems, and one result has been to decrease the use of any single system and to encourage the use of some combination of systems.

ASSESSMENT PRACTICE IN THE UNITED STATES

In 1913 the United States Census Bureau ascertained the policy with reference to special assessments in 219 cities having a population in excess of 30,000. The practice in these cities may be summarized as follows:[1]

[1] BASSETT, "Special Assessments," pp. 40–41.

TABLE XIX.—ASSESSMENT PRACTICE FOR NEW PAVEMENTS

Item	Per cent of cities assessing the cost against property benefited	
Total cost of opening new streets	41.0	
Part of cost of opening new streets	14.7	
		55.7
Total cost of grading streets	38.0	
Part of cost of grading streets	19.1	
		51.0
Total cost of constructing curbs	54.0	
Part of cost of constructing curbs	28.7	
		82.7
Total cost of pavements on streets	47.5	
Part of cost of pavements on streets	25.7	
		83.2
Total cost of pavements in alleys	44.8	
Part of cost of paving alleys	26.4	
		71.2
Total cost of sidewalks	64.4	
Part of cost of sidewalks	19.2	
		83.8

The Bureau of Municipal Information of the New York State Conference of Mayors and other City Officials made an investigation of special assessment practice in 163 cities. Table XX shows the results of this investigation.[1]

The same investigation shows that the application of the principle of special assessments for repaving was by no means as universal as for meeting the cost of construction of the original pavement. Table XXI gives the result of the investigation of the cost of repaving.[2]

The financing of repaving has always been a troublesome problem for municipal officials, and their reluctance to assess the cost in the same manner as that of the original pavement is evidenced by the data in Tables XX and XXI. Undoubtedly, it is much more difficult to sustain the special benefit theory in the case of repaving than it is in that of new pavements. The general benefits that result from repaving are probably more marked and tangible than is true of original pavements. In

[1] *Ibid.*, p. 51.
[2] *Ibid.*, p. 69.

TABLE XX.—PROPORTION OF ORIGINAL PAVING ASSESSED UPON PROPERTY BENEFITED

Percentage assessed	Number of cities
100 per cent	73
98 per cent	7
95 per cent	1
85 per cent	4
$^{5}/_{6}$ per cent	1
80 per cent	1
75 per cent	2
70 per cent	2
$^{2}/_{3}$ per cent	24
50 per cent	15
44 per cent	1
Divided, but no rule	7
None	25
Total number reporting	163

TABLE XXI

Percentage assessed on property deemed to be benefited	Number of cities
100	39
98	2
95	1
85	2
80	1
$66^{2}/_{3}$	15
50	16
$33^{1}/_{3}$	1
25	1
Divided, but no rule	7
No assessment made except by consent or on petition for certain kind of pavement	1
None	70
Policy not determined	7
Total	163

many instances the repaving of streets is almost wholly a general benefit, particularly on arterial ways that traverse residential areas. In a shopping district or any other commercial area, anything that facilitates travel on a street confers a special benefit on the abutting property, but it is questionable if that is true in non-commercial districts. There is a growing sentiment

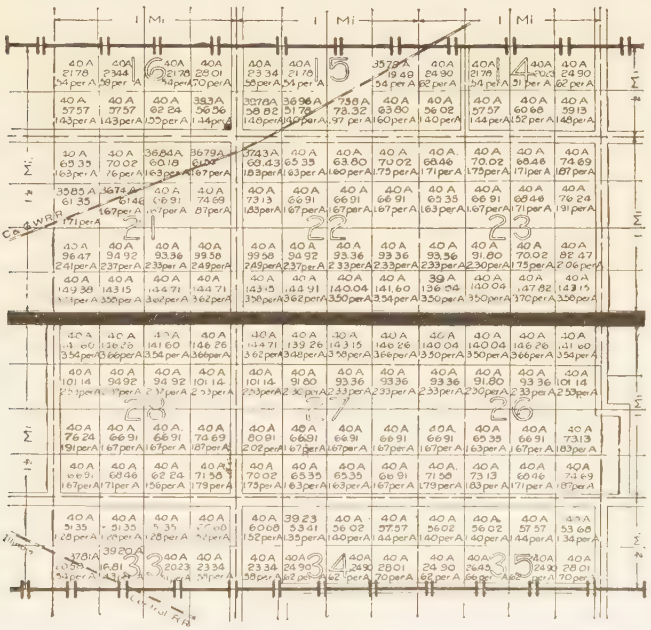

FIG. 10.

Black Hawk county farm land along the Waterloo-Jesup paved road must pay an average for the entire improvement district of $1.93 acre. There are 22,983.16 acres in the district and the part of the total improvement expense which the property owner must pay on the basis of 12½ per cent of the cost of the paving is $44,347.51. One individual forty adjacent to the road in the 12½ miles pays a total of $150.93 or at the rate of $3.77 per acre. Half a dozen other forties pay $149.38, a rate of $3.73 and the balance range on downward to as low as 43c per acre. The land owner may pay the assessment in one sum or may take advantage of the deferred payment plan dividing the amount in ten equal installments. The owner of land assessed at 43c per acre would, under this arrangement, pay 4.3c per acre on his tract each year with interest charges added. The chart shown is entirely typical of any section of the district. It includes a block three miles long and starting one and a half miles east of Waterloo.

in favor of a wider use of the wheel tax as a means of financing maintenance, including repaving; but in many districts a part of the cost of repaving can be assessed to benefited property without injustice.

Special-assessment Districts.—Some of the economic and administrative principles involved in the apportionment of special assessments will be better understood from some concrete

examples. Figure 10 shows a special-assessment district in Black Hawk County, Iowa.[1] Under the Iowa law a special-assessment district for the pavement of country roads may

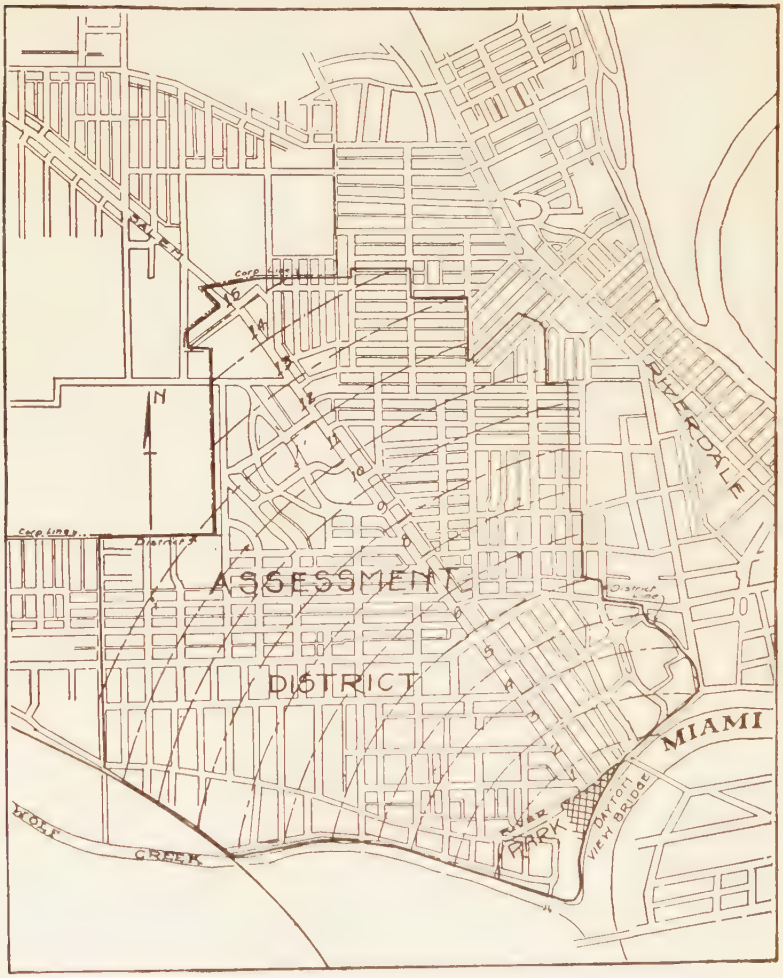

FIG. 11.

extend back 1.5 miles on each side of the pavement. The progressivity of rates of assessment will be apparent from the amounts assessed to the various tracts. Only 12.5 per cent, however, of the cost of the pavement, as the footnote explains,

[1] Iowa Service *Bull.*, vol. 2, p. 9, October–November, 1923.

was paid by the method of special assessment. The balance was paid out of so-called primary-road funds obtained partially from federal aid, but primarily from motor-vehicle taxation.

Dayton View Park.—Figure 11 represents the special-assessment area for Dayton View Park in the city of Dayton, Ohio.[1] This is inserted for the reason that it is such an excellent example of the application of the progressive principle to the levy of special assessments. Table XXII shows the number of benefits for each of the fifteen zones, preliminary and final zone rates, and the preliminary and final assessments required to raise the $55,000 necessary to finance the improvement.[2]

TABLE XXII.—ASSESSMENT RATES, DAYTON VIEW PARK, DAYTON, OHIO

(1) Zone	(2) Benefits	(3) Preliminary zone rate	(4) Preliminary assessment	(5) Final zone rate	(6) Final assessment
1	78.0	$100.00	$ 7,800	$132.72	$10,352.15
2	263.0	27.60	7,260	36.62	9,594.35
3	282.5	13.60	3,840	18.05	5,099.50
4	319.0	9.35	2,980	12.39	3,952.00
5	323.5	8.06	2,630	10.70	3,462.55
6	424.5	6.90	2,925	9.15	3,883.15
7	455.5	5.76	2,625	7.64	3,481.50
8	509.0	5.20	2,640	6.89	3,500.10
9	518.0	4.70	2,440	6.24	3,230.50
10	590.0	4.04	2,380	5.35	3,157.00
11	617.0	3.36	2,070	4.46	2,754.00
12	358.5	2.89	1,038	3.83	1,372.80
13	246.5	2.31	568	3.06	754.30
14	128.0	1.735	222	2.30	294.40
15	73.5	1.146	84	1.52	111.70
Totals...	.....	.....	$41,502	.....	$55,000.00

Detroit.—The city of Detroit, Michigan, is now planning a super-highway development for Greater Detroit, to consist of surface lines for street cars and paved roads for motor traffic outside the city, and perhaps an extensive subway within the city limits although the exact character of the latter improvement

[1] "Special Assessments," by the Committee on Sources of Revenue, National Municipal League, 2d ed., *Technical Pamphlet*, Ser. 15, p. 15.

[2] *Dayton Municipal Review*, Dayton, Ohio, vol. 2, 2, February, 1923.

has not been finally determined. It may consist partly or even primarily of a tunnel way or partly of elevated lines.

The financial plan proposed for the rapid transit system which is a part of the super-highway plan is a concrete example of a large-scale application of certain fundamental principles of public finance which have been emphasized in this treatise. It has been pointed out repeatedly that general benefits should be paid by the community at large through general taxes and that those receiving special benefits should pay part of the cost in the form of special assessments. Attention also has been directed to the justice of requiring those who use the highways to pay a fair share of the cost of construction and maintenance of those highways. The Rapid Transit Commission of Detroit is evidently of this same general opinion.

It is recommended by the Commission that a tunnel way system should be adopted which will cost $4,700,000 per mile. Of this amount $3,200,000 will be expended for permanent way and real estate, and $1,500,000 for equipment. Of the $3,200,000 representing the cost of permanent way and real estate, 17 per cent is to be paid by the city in the form of an *ad-valorem* tax, and the remaining 51 per cent by locally benefited property at rates ranging from 1 cent to 7 cents per square foot per annum. Slightly more than one-half of the total cost of the improvement is, therefore, to be paid by the method of special assessments. These progressive rates for the six zones are as follows:

Zone AA.—All lots, the nearest points of which are within 250 feet from the station entrance, except that along the street traversed by the route, the distance shall be 350 feet from the station in both directions.

7-cent assessment per square foot per year.

Zone A.—All lots (outside of Zone AA), the nearest points of which are within the area included between 250 feet and 500 feet from the station, except that along the street traversed by the route, the area shall be that between 350 feet and 850 feet in both directions for a width of 400 feet, including both sides of the street.

5-cent assessment per square foot per year.

Zone B.—All lots (outside of Zone A), the nearest points of which are within the area included between 500 and 1,150 feet from the station, except that along the street traversed by the route, the area shall be that included between 850 feet (or the outer boundaries of Zone A) and the dividing line midway between stations, in both directions, for a width of 1,000 feet, including both sides of the street.

3½-cent assessment per square foot per year.

Zone C.—All lots (outside of Zone B), the nearest points of which are within the area included between 1,150 and 1,800 feet from the station, except that along the streets parallel to the route, the area shall be that included between the boundaries of Zone B and the dividing line midway between stations, but limited to approximately 650 feet in width where intercepted by the dividing line midway between stations.

2¼-cent assessment per square foot per year.

Zone D.—All lots (outside of Zone C), the nearest points of which are within the area included between 1,800 and 2,450 feet from the station, except that along the streets parallel to the route, the area shall be that included between the boundaries of Zone C and the dividing line midway between stations, but limited to approximately 650 feet in width where intercepted by the dividing line midway between stations.

1½-cent assessment per square foot per year.

Zone E.—All lots lying between the outer boundaries of Zone D and the half-mile limits of the district each side of the line.

1-cent assessment per square foot per year.[1]

The remaining 32 per cent of the total cost, or $1,500,000 per mile, representing cost of equipment, is to be paid for by the car riders in the form of reasonable fares. Mortgage bonds or equipment notes, secured by property and revenue of the system will be gradually amortized out of fares. The Rapid Transit Commission has proceeded on the general theory that the car riders should pay for only the equipment, including the operation and maintenance of the system, and should not pay for the real estate and the construction of the permanent way.

[1] "Proposed Financial Plan for a Rapid Transit System for the City of Detroit," Rapid Transit Commission, Detroit, pp. 45–46, Nov. 27, 1923.

CHAPTER X

TECHNICAL FUNCTIONS OF HIGHWAY DEPARTMENTS

The technical activities of a state or municipal highway department are so diverse and are conducted in so many different ways that a detailed discussion of any particular method of procedure must be considered as suggestive of good practice and no more than that. There may be a dozen different ways of doing a thing, all of which are quite satisfactory. Those described in the following pages will serve to indicate the scope of the work of the technical staff of a highway department, and some of the methods of control employed to insure correlation of the various units of the organization.

Central Office.—The administrative organization is centered in the general office, at which is located the chief engineer, the various bureau chiefs, and the main drafting room and testing laboratory. Here, also, are assembled the correspondence files, the files of plans and technical records, and the accumulation of routine and special reports. The various functions of the central office may be correlated through an office engineer, secretary, or chief clerk. Some departments depend upon regular conferences between bureau chiefs for the correlation of the central office work and dispense with anyone corresponding to the office engineer. The central office is the nerve center of the whole organization because all matters of importance are passed upon here. The outstanding administrative problem is to systematize the routine of the central office so that it does not become hopelessly entangled in paper work and retard, rather than expedite, the work of the field forces. This desirable result is in fact accomplished in some departments, while others are less successful in doing so.

HIGHWAY LOCATION AND DESIGN

Location.—In the established highway systems, the routes of all trunk highways are fixed, but when improvements are ordered the question of location arises. Survey parties are put in the

field and the chief engineer of the bureau of design, or the chief locating engineer, accompanied by the district engineer, makes a careful inspection of the location and determines very closely the route to be followed. The survey party, which varies in size but generally consists of a chief of party, instrument man, two rodmen and two chainmen, will then make a detailed survey along the route selected. Often, in settled districts, this follows rather closely the existing right of way, but in rough or sparsely settled country may follow an entirely new alignment for long distances. The district engineer will keep in close touch with the work and direct minor changes in the alignment as new conditions develop.

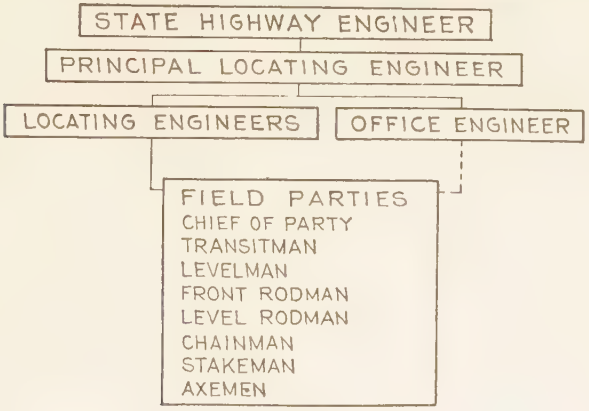

FIG. 12.

In some organizations the survey notes are platted daily by a draftsman who accompanies the survey party, and thus any deficiencies in the survey notes can be corrected while the party is on the site. The organization of a location bureau is shown in Fig. 12.

Design.—When the survey has been completed, the grade line for the improvement may be placed on the working profile under the supervision of the district engineer, or the working profile and the survey notes may be sent to the central office and the plans completed there. It will be noted that the chief locating engineer from the central office has been over the site and has directed the location, thereby gaining first-hand information with reference to the problem of design.

When the notes reach the central office they are assigned to a squad of designers, numbering from four to six, who work under

a squad leader. These take over the survey notes and the working profile that was platted in the field and complete the design of the proposed improvement, all under the supervision of the bureau chief. When the proposed grade line has been established, it quite often proves desirable for the locating engineer and the district engineer to go over the site with the tentative plans to see how the proposed grades fit the location. If the road is to be constructed as a federal-aid project, the district engineer of the federal Bureau of Public Roads will probably accompany the state men in the examination. Thus, all interested will be in agreement before the plans are put in final form.

Final Drawings.—The essential features of the design being settled, the details are completed in the central office and transferred to the final sheets, titled and indexed. Estimates of quantities are now abstracted on special sheets for use in preparing calls for bids. The plans then go to the blue-print department where the required number of duplicates are made and the tracings sent to the files.

Bridges and Culverts.—If the project involves the construction of culverts and bridges, a bridge survey for each structure is made up by the field party and forwarded with the location survey notes. Upon the arrival of these at the central office they are placed in the hands of the bridge engineer or chief bridge designer. He has before him a schedule of the order in which the road projects are to come up for construction and it is his duty to have the bridge and culvert plans completed at the time scheduled. He assigns the bridge and culvert survey sheets to a squad of four or five designers who, like the road-design squads, are working under a squad leader, and they proceed with the design of the structures. If, during the progress of the design, any conditions appear that are not covered by the experience of the designers, they will consult the chief designer or bridge engineer before proceeding. When the plans are completed and approved by the chief engineer, the quantities are abstracted for use in preparing calls for bids. The plans then go to the blue-print department and, finally, to the files.

Standard Plans.—The preparation of the large number of plans for roads and bridges required by a highway department scarcely could be accomplished if the design practice of the department were not reasonably well standardized. In every department the staff has developed standard bridge and culvert

plans in such numbers that most of the ordinary conditions are provided for. The design of culverts, then, consists of scarcely more than marking certain dimensions on the standard plans, and titling and indexing. Road plans cannot be so fully standardized, but all the details and appurtenances are usually covered by standard plans. Hence, it is not necessary to make a special design for guard fence, earthwork cross-sections, road surface cross-sections, or the many supplementary details such as storm-water inlets. The treatment of curves as regards widening and superelevation is standardized and tables and diagrams are drawn up to show the adopted design. These standards, together with the formal written instructions to designers and occasional general conferences, serve to unify the design practice.

It is perhaps undesirable to carry standardization to a point that will discourage the exercise of initiative on the part of designers, nor should rigid adherence to standards be enforced when there is an opportunity to save money or to create a better design than is incorporated in the standards. So many locations are essentially alike that the design which is suitable for one is satisfactory for all of the others. That being true, a standard design can be created that possesses the utility demanded, is sightly, and can be constructed within the limits of cost prescribed. When the site for a bridge or the location for a highway presents conditions that are out of the ordinary, a special design should be developed to meet the situation. If a department insists on slavish adherence to standards, the staff may become indifferent to the adequacy of their designs and lose the incentive and inspiration so needful for originality in design. This is the danger of overstandardization of designing or any other engineering activity.

MATERIALS TESTING

Inspection of Material.—One of the striking differences between present-day highway control and the older systems, is evidenced in the care that is now exercised to determine whether materials are suitable for the contruction of which they are to become a part. The science of road-material testing has made very great advances during recent years, due, in great measure, to the researches of the highway departments. The materials-inspection service of these departments is generally very comprehensive and the methods technically accurate and thorough.

The functions of a materials-inspection bureau are:

1. To test all materials that enter into any construction that is under the jurisdiction of the department which the bureau serves.

2. To develop, through investigation and experiment, new sources of materials or better ways of utilizing materials already in use.

3. To conduct research in the properties of materials, or of the behavior of structures, with a view to increasing the life of roadway surfaces and supplementary structures.

Materials testing is deemed of sufficient importance by some departments to warrant constituting the testing organization a bureau reporting directly to the chief engineer. This is perhaps logical, because materials will be tested in connection with at least three major functions of the department—road construction, bridge construction, and maintenance. In other departments, the testing is organized as a division of one of the major bureaus, usually the construction bureau. In whatever form the organization appears, it serves the entire department, testing all materials that are used in any of its activities.

The equipment of the testing department consists of a central laboratory which is often very elaborate, district laboratories, and portable laboratory kits that can be used in the field wherever it proves desirable.

Routine Testing.—The routine testing of materials that are being supplied for construction and maintenance constitutes the largest activity of the testing bureau. An attempt is made to test materials at the place where they are produced, if it is at all feasible to do so. This system contemplates that all materials shipped to a job are of the specified quality. It eliminates, moreover, delaying the use of the material after it reaches the job in order to sample and test. If materials in considerable volume are shipped from any one district, a branch laboratory will be set up in the most convenient town, and all shipments going out from the district will be sampled and tested by the personnel of the district laboratory.

Materials inspectors with portable kits of laboratory equipment are sent to isolated plants that are furnishing materials regularly and in quantities. If occasional shipments are made from isolated plants, the materials, of necessity, will be tested on receipt at the place they are to be used.

Routine tests are applied to all kinds of materials and, in order to correlate the work of the various testing engineers, the central laboratory is constantly running check tests on samples of materials that have been tested at the various district and field laboratories. From time to time field and district laboratory men are brought in to the central laboratory for instruction and to be given practice in performing tests in accordance with the standards adopted for use in the department.

Research.—An important function of the materials-inspection service is the conduct of investigations and research in the use of materials. Investigations of possible new sources of materials often develop new supplies of road materials or means for improving the quality of the product obtained with materials of the types already in use.

Researches are undertaken to uncover the basic properties of materials or to develop new facts with reference to the behavior of the customary types of construction. Research has become an important factor in the operation of all progressive highway departments and is one means of keeping the work of the department in harmony with the progress in scientific knowledge concerning highway construction.

Standardization.—Uniformity of practice among the states with reference to materials inspection, is promoted through a special committee of the American Association of State Highway Officials and the standardization work of the American Society for Testing Materials.

The supervision of the construction of federal-aid roads by the Bureau of Public Roads is also an important factor in promoting standard methods of materials testing.

CONSTRUCTION OF HIGHWAYS

The construction of highways is sometimes performed by the day-labor method, but is much more commonly accomplished through contracts awarded on the basis of competitive bids. There has been, and always will be, much discussion of the relative merits of the two methods, and the various considerations involved are presented in another place. Under either system there must be a bureau of the highway department engaged in the supervision of construction. When the contract method is employed, the bureau will be concerned mainly with the inaugu-

ration and inspection of construction, the checking of progress on the various jobs, and the preparation of partial and final payment estimates on contracts.

Inspection of Grading.—The duties of an inspector on grade-reduction and general-grading contracts consist in setting stakes for the guidance of the constructor, checking the work that is supposed to be completed, and the preparation of estimates of quantities for use in making payments to the constructor. The supervision is generally organized under a resident engineer who is, in fact, the chief inspector for the project. He may be called an inspector or he may be known officially as the resident engineer. If the job is of sufficient magnitude, he will be assigned a survey party consisting of an instrument man and two assistants, who serve as rodmen and chainmen. On the smaller jobs the resident engineer sometimes serves as chief of party. If conditions are favorable, the resident engineer may supervise two contracts and may need a survey party on each contract, the resident engineer dividing his time between the two. This is easily possible if the two projects are sufficiently close together that not more than an hour or so is required to drive from one to the other.

The problems of inspection on this type of construction are comparatively simple. The first is to make sure that the site of embankments is cleared, and in the case of side-hill work, plowed or benched, as may be provided in the specifications. The second is to set the slope stakes to indicate cut and fill. The third is to check the elevations of completed work, which usually involves setting grade stakes to show finished grade. The fourth is to stake out farm entrance grades and alignment, and to perform the same office where intersecting roads are to be graded to meet the road that is under construction. The fifth is to check the side slopes of cut and fill, and to insure that the slopes of cuts are trimmed as provided in the specifications and to see that all of the work is trimmed up as required. The sixth is to prepare at stated intervals estimates of the quantity of work that has been completed.

Inspection of Gravel Surfacing.—In most of the highway departments it is the practice to require the gravel to be inspected by the materials-inspection bureau at the plant where produced. Generally, the road surface upon which the gravel is to be placed already has been checked and approved by the grading inspectors. In this situation the only inspection required during the placing

of the gravel is that which will insure the proper quantity of material being placed on the road.

The capacity of each vehicle used for hauling gravel is determined in cubic feet and marked on the body of the vehicle. The inspector is furnished a table showing the length of road surface that can be built with loads of various sizes. He sets stakes on the road to gage the dumping so that the proper thickness is insured for each load as shown by the table. The inspector is sometimes furnished printed load tickets which he fills out in triplicate for each load. One copy of the ticket is retained by the inspector to be attached to his weekly report, one is delivered to the driver of the vehicle, and the third is given to the contractor. In other cases, the loads are tallied on a sheet which is ruled to provide a column for each vehicle that is hauling. A carbon copy of the sheet is furnished to the contractor each day and the original is turned in with the inspector's weekly report.

The materials inspector does his work at the gravel pit from which the material is being furnished. The supply is sampled and tested, and the report on the test sent to the central office. If the material is satisfactory, the supply is approved for use with the proviso that the pit shall be properly stripped and the gravel screened to the sizes provided in the specifications. The materials inspector then makes an examination of the pit and plant when the constructor is ready to start production. If everything is satisfactory, the work proceeds and periodic visits of the inspector are sufficient to insure a reasonably uniform product. It becomes necessary in some instances to keep an inspector at the gravel pit, because the deposit proves to be variable in character or the constructor fails to give the proper supervision to the gravel pit operation.

When the gravel is shipped by rail, each car is sampled, tested, and approved before it is billed out to the job.

Inspection of Asphalt-pavement Construction.—Whether the earthwork preparatory to laying the pavement is performed in connection with the pavement construction or is a separate contract, the inspection will require about the organization described for grading contracts.

A paving project is supervised by a resident engineer, who is assumed to understand all of the various operations involved. He is responsible for the efficiency of the men assigned to the detailed inspection of the several operations.

There will be a survey party consisting of a chief and two rodmen, who set grade stakes for the form setters and the gang that is preparing the subgrade for the pavement.

The concrete base may be constructed by the dry-batch method, wherein the concrete aggregates are measured into trucks or batch boxes at a plant set up at a railway siding or at a gravel pit. One inspector is required to be in constant attendance here. If the wet-batch method is used, the concrete will be mixed at this plant, and one inspector can supervise all of the operations.

Another inspector is required on the road or street at the place where concrete is being placed. He checks the time of mixing, the consistency, the final trimming of the subgrade, and the finishing operations on the concrete base.

If separate curb or curb and gutter are being constructed, the survey party will be required to set the grade stakes for curb, except for small jobs where the inspector sets the grade stakes with the aid of one or two laborers. The proportioning, placing, and finishing of the concrete curb can be inspected by one man.

At the asphalt plant a plant laboratory and the continuous services of one inspector are required. He checks the consistency of the asphalt cement, the proportions of the mixture, the temperatures, and the size of the load sent out from the plant.

Another inspector is required to supervise the laying of the asphalt surface. His duty is to see that the proper thickness is laid, that it is raked and rolled in a suitable manner, and that the finished surface is of the prescribed smoothness. The thickness is checked by pushing thin, sharp-pointed rods through the surface to the base, but the principal dependence for securing the correct average thickness is placed on requiring each load to be spread to cover a calculated area of base. The weight of each load is known from the batch ("box") weights established by the plant inspector, who also informs the resident engineer of the number of batches per load. Generally, there is a ticket sent out with each load with the number of batches marked thereon. The weight per square yard of rolled surface is readily determined for each type of mixture, and the spread per load then can be established. This is marked on the curbs or indicated by pins set along the curbs.

The sufficiency of the rolling is determined by observations of the effect of additional rolling and the smoothness is checked

by a straightedge. Generally, it is required that there be no depressions exceeding ¼ inch with a straightedge placed parallel to the curbs.

Inspection of Bridges and Culverts.—The inspection of the construction of small bridges and culverts has been a neglected factor in highway administration due to the difficulty of furnishing inspection for work that is made up of small units widely scattered over a state. In recent years, however, a system has gradually developed whereby this construction is given a reasonable amount of supervision. The problem is greatly simplified if a constructor is awarded a contract for a number of structures in a single county or in two or three adjacent counties. An inspector is assigned to a certain group of structures and his first task is to check the quality of the materials that are delivered to the several sites. By means of a portable kit of testing apparatus, the concrete materials are examined and usually there is ample time for this before the constructor is ready to use any of the material. Samples of the reinforcing steel are sent to the central laboratory to be tested. If fabricated steel is to be employed, it is generally inspected at the fabricating shop by a representative of the central laboratory and is approved before it reaches the site of construction.

As the construction proceeds, the inspector checks the excavation to insure that footings are of the right dimensions and depth. He can perform this duty on several structures in one day. When the forms are completed and the steel reinforcement placed, the quantity and placement of the steel is checked. Generally, the constructor will be placing concrete on but one structure at a time, and the inspector can stay on the job during this operation. If a steel superstructure is being erected, the inspector can check the dimensions of the members after they have been delivered at the site, and after erection he can check the field riveting.

Thus, one inspector can supervise the construction of many structures during a season.

If a bridge is of some size, a resident inspector will be assigned to the job and will devote his entire time to that project until it is completed.

CORRELATION OF INSPECTION

It is desirable, of course, to secure uniformity of practice among the inspectors of a department, which is accomplished in

two ways. The first is by utilizing general inspectors and district engineers. The district engineers visit all jobs in the district rather frequently and thus are able to keep the inspectors working in harmony with the policies of the department. In addition, general inspectors are sent out from the central office with the district engineer to visit all work in a district. They spend enough time in each district to make sure that the district engineer and his inspectors are working in harmony with the policy of the department and are competent and effective.

The second method of correlating the work is by means of printed instructions which are furnished to all inspectors. These aim to make clear the exact status of the inspector and to inform him just how to proceed with his work. In general, he is not given final authority in matters that come to an issue between himself and the constructor, but is required to report to the district engineer for instructions.

Types of Inspectors.—The inspection of low-grade surfacing and tiling does not require the services of technically trained men. The duties are of such a nature that men who have had a reasonably good common-school education and some practical experience and who have learned to do simple surveying can readily be trained into satisfactory inspectors for these classes of work.

The inspection of any kind of construction involving accurate surveys of some complexity, the use of concrete and bituminous materials, and all high types of road surface, requires the services of technically trained men. In rare instances a man comes up through an organization, gaining experience and learning the technical side of the work as he progresses, until he finally reaches a stage of proficiency that is adequate for an inspector; but, as a rule, the highway departments depend upon technical graduates to man the inspection staff, and quite often the first job a college graduate secures is that of an inspector. There is some criticism of this policy of using inexperienced engineers on inspection, and doubtless some reason for it; but the practice could hardly have prevailed for so many years if it did not represent the best solution of the problem.

If the college graduate is so fortunate as to be assigned first to a survey party, then pass to chief of party, and from there be transferred to the inspection staff, he will be well qualified to learn the duties of inspection. It has been the policy to have experienced men as resident engineers on construction, and these

keep close supervision of the inspectors, giving them authority gradually and relieving the unfit before they can do harm. It has been found that, as a rule, college-trained engineers develop rapidly, are resourceful, painstaking, and possess considerable enthusiasm for their work. On the whole this system of providing inspection is by all odds the best that has been devised so far.

The system of inspection employed in many cities for the supervision of the construction of pavements is totally different from that which has been described in that it is non-technical. For many years the job of paving inspector has been a part of the political patronage of the ward boss or alderman. The result is that the pavements are all too frequently constructed without any inspection worthy of the name. Under the competitive conditions existing in the contracting field, it is not unlikely that constructors often take advantage of this lack of inspection.

District Engineers.—The state highway departments and the federal Bureau of Public Roads have found it to be advantageous to employ a district or a division engineer as an aid to the control of operations at a distance from the central office. The district engineers are seasoned and experienced employes of the department and are the representatives of all bureaus of the central office. All activities of the department in the district are supervised by the district engineer, including construction of roads or bridges, surveys, inspection, and maintenance. In the district office are such assistants as may be required to enable the engineer to perform his duties. In the main these consist of supervisory activities, although in some states the plans for new roads are prepared in the district office. The districts are of such size that the engineer can visit all work in his district at frequent intervals during the period of construction and can travel the state roads with sufficient frequency to check the effectiveness of the maintenance forces.

District engineers have a rather wide latitude with reference to final decisions in matters that come to their attention, but in general are expected to settle the minor questions at once, while those involving general practice or policies will be referred to the proper bureau of the main office. It is sometimes rather difficult to determine whether a question is a minor one or not, and the decision will depend a great deal upon the practice in the particular department. Generally, the district engineer is

expected to keep things moving and to settle all questions that are covered by definite instructions from the main office.

PREPARATION OF SPECIFICATIONS

The specifications employed in connection with contracts for rural highways and for municipal street improvements may be considered as of two classes—standard and special. This classification is purely one of convenience, since parts of each class follow certain generally recognized standard specifications. The department standard specifications have been so generally adopted that they constitute the predominating type employed as a basis for contract highway construction; but special specifications have a wide field of use.

Both types of specifications serve as the basis of agreement between the constructor and some public board, and, as such, their form and requirements exert considerable influence on the cost of performing highway work. Not infrequently, a specification for highway construction is encountered that is so grossly unfair in its requirements and so full of ambiguity, freak provisions, and contradictory statements as to create the impression that the writer of the specification had but the haziest of notions what he ought to require of the constructor. It is inexplicable that anyone can be induced to submit proposals for work to be performed under such specifications, and a still greater wonder that it proves possible to complete a contract, once it is undertaken. The country is strewn with atrocious roads and pavements that are monuments to inexpert specification writing. To be sure, it is never certain that a highway project will be completed in such a manner that it is as serviceable as could be expected under the specifications, but it is fairly certain that no job will be any better than is contemplated by the specifications.

The obligation of the specification writer is definite and inescapable. He must prepare his documents so that the responsibility of the constructor is set forth with definiteness and likewise his rights are recognized and protected.

Department Standard Specifications.—The federal Bureau of Public Roads, the various state highway departments, many city engineering organizations, and even a number of counties have evolved standard specifications for the various classes of highway work under their jurisdiction. These specifications are quite frequently the result of many years experience and, through suc-

cessive revisions, have been brought to a high state of perfection. The constructors who work under any such standard specification soon become familiar with the provisions thereof and know the character of work that is contemplated. As experience indicates the need of revision, the standards are modified and reissued. These changes come about rather gradually and constructors and supply concerns find little difficulty in accommodating themselves to the new conditions that may be imposed.

Special Specifications.—Some highway construction projects involve so many special conditions that it is undesirable to employ departmental standard specifications in their entirety because of the large number of changes and additions that would be required. Special specifications are accordingly prepared which may or may not include considerable material that is carried by the departmental standard specification. Some consulting engineers prepare special specifications for each project they have in charge. These are likely to be changed but little for successive projects, but always must be scrutinized carefully by the constructor to make sure what is included. In any special specification there is likely to be a considerable amount of material identical in character with that which is to be found in the departmental standard specification.

It is in the special specification that one is most likely to encounter evidences of carelessness, ignorance, and a failure to sense the high responsibility involved in the preparation of contracts involving the expenditure of public funds. The inclusion of archaic, irrelevant, or vicious provisions is all too common, and endless repetitions serve to prolong the specifications to unbelievable lengths. In many cases the thread of intent is lost in the twistings and turnings of paragraph after paragraph of meaningless piffle. They preserve a semblance of specification form through the employment of a semilegal jargon and frequent reference to the "engineer" and the "contractor." The words "shall," "must," "shall not," and "it is required" make a brave showing of serious intent, but the flimsiness of the really essential provisions reveal at once the incompetence of the writer. Ability to write clear, concise, equitable, and adequate specifications is not quickly attained, but once achieved is one of the most valuable elements of the engineer's equipment.

Many excellent treatises on specification writing are available, and it is not the purpose of this discussion to elaborate the tech-

nique of specification writing, but rather to present some of the applications to highway construction of the basic principles of specification writing.

Purpose of Specifications.—The specifications that accompany a contract for construction constitute an important part of the basis of agreement between the contracting parties. As such it should be obvious that, so far as it is humanly possible, specifications should be susceptible of one, and only one, interpretation. The constructor, in consideration of an agreed compensation, undertakes to perform certain work. The purpose of the specification is to inform him exactly what he is to construct and, often, the particular manner in which he is to perform some of the operations involved.

It often transpires that the inspection of the construction is carried out under the supervision of an engineer other than the one who prepared the specifications. His knowledge of what was intended must be secured by reading the specifications. The public, which supplies the funds for paying for the work, has an interest that is paramount and that must be recognized. That interest dictates that the specifications must not only be unequivocal, but must also provide construction adequate for the service to which the structure will be put.

Influence of Specifications on Price.—Much has been written about the influence of fair specifications on the prices submitted for the work. Since most of the highway construction is awarded on sealed, and presumably competitive, bids, it may be assumed that, in the long run, lower prices will be secured if the specifications are free from provisions that may lead to friction, misunderstanding, or controversy; or that may be invoked to cause work to be performed in such a manner as to increase materially the cost above that which it is expected to be under the normal process.

What constitutes a fair specification depends to some extent, perhaps, upon the viewpoint. A provision that seems quite fair and necessary to the engineer might impress the constructor unfavorably and cause him to add a little to his estimate. In the main, fair specifications are clear specifications that recognize the hazard of highway construction and contain no provisions that would penalize the constructor for difficulties that might arise because of conditions over which he exercises no control.

Many questionable provisions appear in connection with that portion of the specification that deals with the administration of

the contract and the authority of the several officials in connection therewith. It seems to be assumed that the constructor is endowed with clairvoyant powers and therefore can foresee just what decisions will be reached by the engineer or official board in matters left to their determination by the specifications. All such provisions should be avoided and the precise procedure in each probable contingency should be stated definitely.

There is a limit beyond which it is impossible to go in this direction without jeopardizing the durability of the product and the constructor must, and does, expect to be held responsible for damages to his work because of inclement weather or casualties of any kind. Since any kind of constructor may submit a proposal, moreover, the specifications must contain certain provisions of a rather arbitrary character so as to protect the public from the careless or incompetent constructor and his representatives. Provisions of this type are sometimes an occasion for concern on the part of high-grade constructors, because they never feel certain that the provisions will not be invoked against them. This situation cannot be remedied until some workable method has been evolved for eliminating the incompetent and dishonest constructor from competition for public contracts, a problem that will be long in the solving.

Influence of Specifications on Quality.—Poor work is frequently done under good specifications, but it is rare indeed that the quality of the product is higher than that provided for by a fair interpretation of the specifications. It cannot be otherwise under a system of competitive bidding. The obligation, therefore, rests upon the specification writer to provide for construction of the required degree of durability. It is, of course, incumbent on the inspection agency to secure construction of the quality contemplated in the specifications, but the specifications set the standard. Adequate specifications for highway construction can be prepared only by one who is familiar with every technical requirement involved.

Influence of Specifications on Inspection.—The trained inspector seeks to visualize the structure provided for in the specifications and will assist the constructor in securing the product intended. If the specifications are complete and clear, there will be little difference of opinion between inspector and constructor as to the intent of the specifications. If the specifications are ambiguous or incomplete, the inspector will often find

himself unable to say with certainty what was intended. Endless bickering with the constructor is likely to result. The inspector will become discouraged in attempting to bring up the quality of the work and, more or less, will follow lines of least resistance in dealing with the constructor and the problems that arise from day to day. The influence of the specification on the morale of the inspector is marked, and good specifications tend to create an atmosphere favorable to the most effective work on the part of the inspector and to insure the utmost diligence in the performance of his duties.

Content of Specifications.—In state highway work, and in municipal highway work in some states, specifications are accompanied by detailed plans and the two are supplementary. The plans show the location, grades, form, and dimensions of the proposed improvement, while the specifications deal with the administration of the contract and with the quality of the materials, the sequence of operations, and types of equipment to be used, and set up standards of workmanship. Under these conditions the specifications need not, and usually do not, cover dimensions or form as those can more readily be shown by drawings. The inclusion of data with reference to dimensions and grades increases the volume of a specification very greatly and is to be avoided wherever possible.

In some states the statutes with reference to improvements that are financed by the special-assessment method require that all matters of specification and design be included in an ordinance which must be legalized before a contract can be awarded. In such instances the specifications and the plans are combined in written form. Legal procedure relating to ordinances of this type has become exceedingly complex, and this, together with the effect of court decisions on the subject, has created a most deplorable situation. To frame an ordinance of this type so that it will be invulnerable to legal attack is well-nigh impossible. If the ordinance writer is at great pains to include full descriptions of the most minute details of the construction, which seems to be necessary, the ordinance becomes so voluminous that it is doubtful if anyone save the writer is ever fully aware of the contents.

When the engineer must proceed under this system, it is incumbent upon him to exercise the utmost care in wording every sentence of the ordinance and to revise and check his proposed

ordinance repeatedly. Even then, he is likely to find that a misplaced comma or typographical error in copying will nullify his effort. The system seems to have been devised to create business for the legal profession.

Some engineers elect to include in ordinary specifications certain dimensions and the description of certain forms the completed work is to take. There is no objection to this save the possibility of a lack of agreement between the plans and the specifications, and it is probably better in most instances to avoid including design data in the specifications.

The difference between the two types of specifications just referred to may be illustrated by quoting a part of the clause relating to combined curb and gutter as it appears in a set of specifications which are accompanied by detailed plans, and, following that, to quote the same specifications as they are written when plans are not referred to.

1. *Combined Curb and Gutter.*—The combined curb and gutter shall be of the form and dimensions and in the location shown by the plans and it shall be constructed with the top of the curb at the grade elevations shown on the profiles in the plans. The curb and gutter shall be constructed of concrete mixed in the proportion of one part cement, two parts of sand, and three parts of broken stone . . . , etc.

2. Along each edge of the pavement with the front face of the curb at a distance of 15 feet from the center line of the pavement and parallel to the center line thereof, except at street and alley intersections, there shall be constructed a combined concrete curb and gutter. The gutter slab shall have a width of 2 feet and a thickness of 6 inches with a slope toward the curb of 1 inch. The curb shall be constructed integral with the gutter slab and shall be 6 inches thick and shall extend from the bottom of the gutter slab to a height of 6 inches above the adjacent surface of the gutter slab. The upper edge of the curb toward the pavement shall be rounded to a radius of 2 inches and at the junction of the gutter slab and curb there shall be a fillet of a radius of 1 inch. At alley intersections the curb and gutter shall be turned to a line parallel with the center line of the alley and 8 feet therefrom by means of a curved section with a radius of 6 feet measured to the front face of the curb, and shall extend to the property line. At street intersections the curb and gutter shall be turned back to form a junction with the curb and gutter on such intersecting street by means of a curved section having a radius of 20 feet . . .

General Provisions.—The typical specification for highway improvement carries two classes of subject matter, each of which

is usually embodied in a distinct section of the document. One class is intended to regulate the general administration of the contract and sets forth the time and place at which bids will be received, the kinds of bids that will be considered, the manner in which payments will be made, and similar subject matter. Many legal questions present themselves during the writing of this part of a specification, and familiarity with contract law is most essential in this connection. There have been so many unwise provisions in the general clauses of current specifications that an attempt has been made to develop national standard general clauses for engineering construction. The committee instituted for the purpose has submitted a tentative report which has considerable merit. Whether it will be finally adopted by any considerable body of the contract-writing profession is not at this time determined. There is a set of general clauses in use among architects which seems to have been accepted as a quasi-national standard, and there seems to be no valid reason why the provisions relating to engineering construction also should not be substantially alike for all classes of highway construction throughout the nation.

The second type of subject matter is descriptive of the methods to be followed in the actual construction of the highway and of the materials that are to be used. This portion of a specification deals with subjects that are wholly engineering in character, and the writing involves the most minute knowledge of the composition of the contemplated type of road and of the construction methods that seem to produce a road of the greatest serviceability. Good construction specifications are usually the outgrowth of long experience and painstaking improvement which is accomplished year after year as the specifications are used and the results obtainable become established.

AIDS TO SPECIFICATION WRITING

The general characteristics of highway specifications have been outlined and the necessity for excellence in these documents pointed out. The beginner in specification writing will find certain indispensable aids in engineering literature and the experienced specification writer will hardly find it possible to dispense with them. The most valuable aids are: (*a*) a good treatise on specifications and contracts, of which several are available; (*b*) an

author's manual prepared particularly for engineering subject matter; (*c*) copies of laws and ordinances relating to contract work in the locality; (*d*) copies of municipal and state highway department specifications; (*e*) national society specifications; (*f*) trade association specifications; (*g*) specifications issued by the producers of road materials; and (*h*) abstracts of the methods of construction employed in current highway work. These will now be discussed in detail.

Reference Books.—The engineer who has had long experience in the preparation and use of specifications and who has kept abreast of the times has occasional need of authentic reference books on specification writing, and the beginner will find them of the greatest service. There is a rather copious literature on the subject in which the fundamentals of good specifications are presented in the light of judicial decisions and the best contract practice. The subject is frequently discussed in periodical literature, and courts are continually interpreting laws and passing on the equity of particular contract practices. These things are effecting a gradual change in the form assumed by specifications, but, basically, the law of contracts and the legal and ethical questions that form the foundation for specifications change but slowly. One or two good reference books on the subject, therefore, will prove useful, when the writer is seeking a solution to some troublesome problem in connection with the details of the specifications he has in preparation.

Manuals.—Few, indeed, are those who can write of technical matters without falling into the use of a restricted vocabulary and the overworking of certain words or expressions. Clearness may not suffer from this condition, but the impression created upon the reader is likely to be adversely affected by endless repetitions of trite or incorrect phrases. To split an infinitive at will is the inalienable prerogative of the engineer, but the oft-repeated use of such expressions as "shall," "shall not," "necessary," "intent of specifications," "to the satisfaction of the engineer," and "will be required" becomes monotonous and tends to render them meaningless and ineffective. By means of a good author's manual, the dictionary, and a book of synonyms many of the inelegant, irrelevant, and inexact expressions can be eliminated. The result will be a specification that is clothed in exact and forceful language which will contribute to the effectiveness and clearness of the various provisions.

Law Codes and Books of Ordinances.—It rarely happens that the engineer can write into a specification all of the provisions he would like to include, because of limitations imposed by law or ordinance, and many sections will of necessity assume a form that is not to the liking of the engineer for the same reason. It is possible that the law relating to a particular locality is so well known by an engineer that no reference thereto need be made in order to avoid legal pitfalls. Another engineer might not be so fortunate as to have that knowledge, and his recourse would be to read the laws and ordinances relating to his project before writing a specification, and to have reference thereto as the need arose during the progress of the formulation of the various clauses of the specification.

Departmental Standard Specifications.—Department specifications are of inestimable value to the specification writer, since they form a record of what has been considered good practice by the organization that sponsored them. It is well to secure the standard specifications from a few state and municipal highway departments that are known to conduct their work on a high plane. These may be studied and indeed certain parts may be copied without change; but extreme care must be exercised in copying from any specification, because the special conditions under which work will be performed, or legal or financial considerations may cause a department to insert a provision in its specification which would be wholly inappropriate under other circumstances. Some archaic provisions of specifications, long since abandoned by the department that originated them, come to light in some distant place, having been copied and recopied over and over again because of some seeming aptness of form, when in reality they have no place for use anywhere in a good specification.

Standard specifications issued by well-organized highway departments are an aid to the specification writer under another jurisdiction, but it is generally unwise to use any of the material directly without scanning it minutely to make sure it fits the new conditions. The lazy engineer writes specifications with a paste pot and a pair of shears, but it is certain that in the end he will come a cropper because of including inappropriate material.

National Society Specifications.—The great national and international technical societies have performed an invaluable service in the standardization of certain specifications applicable to the

field of activity of their membership. In the highway field, the organizations that have been most active are the American Association of State Highway Officials, the Society for Standardizing Paving Specifications, the American Concrete Institute, the American Society for Testing Materials, and the American Society of Civil Engineers. These organizations have confined themselves largely to the standardization of terms relating to highway work, to the development of standard specifications for materials or products, and to methods of testing. Their publications are indispensable to the specification writer, since their standards are developed with the most painstaking care by engineers and technicians of the highest professional standing.

National society standard specifications are intended to be so written that they are applicable to any ordinary situation, which is accomplished by providing that the user shall insert certain words or figures in the standard form. Some experience and a lot of care are required in filling in the form specifications in individual cases, but the fact that the general form is worked out and a minimum of material is to be supplied by the user makes it very convenient to use these specifications for many purposes. Sometimes, the specification is applicable without change, as is the case with the standard specifications and tests for Portland cement, promulgated by the American Society for Testing Materials.

Trade Association Specifications.—Numerous trade associations have been formed to promote the use of the products of the members. Of these associations there are several that furnish materials for highway construction, the best known being: the Asphalt Association, the Portland Cement Association, the National Paving Brick Manufacturers' Association, the Crushed Stone Association, and the Blast Furnace Slag Association. In order to promote the adoption of suitable provision with reference to their materials and to stimulate the consideration of their materials in connection with proposed improvements, these associations distribute specifications covering the types of construction in which their materials are employed. These specifications are of varying degrees of excellence and must be used with considerable discretion. They may be suitable for use without modification, but, generally, they require a good deal of adapting before they can be applied to a specific location. They are intended primarily to show in a

general way the usual method of utilizing certain materials. Specifications of this type are valuable aids, but should be looked upon in the light of aids rather than as ready-made specifications. It is unfortunate that the competitive viewpoint so often dominates, and the engineer is likely to be placed in a most embarrassing situation if he uses trade-association specifications without critically examining every provision.

Trade Specifications.—Manufacturers who are not identified with a trade association sometimes furnish specifications covering the types of construction in which their materials are employed, and such specifications are similar to the trade association specification, except that, as a class, they are considerably less reliable. They are useful for occasional reference but are rarely suitable for use without important modifications.

Securing Competition for Highway Contracts.—The assumed purpose of awarding contracts for public highways on the basis of competitive bids is to secure the lowest price consistent with the performance of the work according to the strict interpretation of the specifications. There is reason to doubt the possibility of actually securing real competition by any device of the specification except for limited periods of time, and, even if it could be secured, it might necessitate finding some means of eliminating the incompetent constructor who happened to be the low bidder. Certain types of specification provisions, however, assist in discouraging the pooling of bids and encourage participation in the bidding by constructors of the most competent class.

Competition between Types.—If there is more than one type of road surface that is acceptable for a project, bids may be asked on each of the types that could be used. In doing this, it is imperative that the design of all types be based on the same loads and, so far as the present state of knowledge permits, the several types should be designed for equal serviceability. Too often the designs of competitive types are not equivalent, being intended to permit bids of about the same price for each type. Such an arrangement is very likely to result in the adopting of a type of roadway surface that is not the most economical, although the scheme may have been useful in stimulating competition among the bidders.

Competition between types can be encouraged by reserving the right to award to the lowest bidder on any type. This is not possible in those cases where the state laws require the type

of improvement to be selected before bids are received, but this does not generally apply to state or county road work, being rather a part of the legislation relating to street work.

Accurate Estimates of Quantities.—A constructor must safeguard himself against a decrease in the total quantity of work to be done after bids have been received. It is not generally understood that such decreases may affect the contractors' costs very greatly, and if the estimates are not of assured accuracy the bid price must take account of possible decreases in quantities. To secure the best bids, then, there should be accurate estimates of quantities which may be guaranteed not to be changed more than a certain small amount, say 10 per cent.

Partial Payments.—Liberal provisions with reference to partial payments will also serve to lower the prices bid for performing highway work, since they relieve the constructor of part of his carrying charges. In recent years it has been customary to include in partial payment estimates the quantities of materials on hand, but not yet incorporated in the work, provided these are stored so they will not deteriorate in value before being used. It is also desirable to limit the percentage of earned compensation that is retained to insure completion of the project. In the past the percentage retained was from 15 to 25, but more recently these have been reduced somewhat, and 15 per cent is probably the usual maximum, with some contracts providing for the retention of not over 10 per cent. When it is considered that the constructor has paid for the bond which was filed to insure completion, the necessity for any considerable retained percentage is not apparent.

Unfortunately, the laws relating to municipal improvements usually provide that the constructor shall be paid only upon completion and acceptance of the project. In such instances the specifications can provide no relief.

Arbitration.—It is usually assumed by specification writers that the engineer (who is generally the specification writer) is to be a sort of glorified umpire, in which capacity he is to decide all questions of issue between the parties to the contract. Now, an umpire must be without bias, and to be without bias he must not be beholden to either party of the contract; but the engineer is employed by one party to the contract—the board for whom the work is being performed. No doubt, most engineers do strive to administer construction contracts in an impartial

manner, but personal interest is almost certain to obtrude at one time or another. It is a one-sided arrangement when the engineer is denominated the arbitrator of all questions that arise, leaving an appeal to the civil courts the only recourse to a dissatisfied party. Hence, there has arisen the custom of providing for arbitration boards that may be invoked by either party to the contract, these boards to be constituted in such a manner as to be impartial. The inclusion of a provision for arbitration is a good thing for all concerned, and is especially calculated to give to the constructor a feeling of security and a guarantee of good intent on the part of the supervising agencies that are likely to result in some reduction in the allowance that the bidder usually makes for contingencies.

These various specification provisions create a condition favorable to low prices for contract work, but whether real competition will be had depends upon the conditions that exist where the bids are being received. It is doubtful if unrestricted competition exists on any considerable percentage of the highway contracts that are awarded, nor is it to be expected that such a condition can be created in any district except for short periods of time. This is not a cause for concern because the public can be protected from excessive prices by the refusal of officials to award contracts when prices are not on the proper basis. In the last analysis that is the only sure protection. If the work is of such a type that it cannot be deferred, it may be possible to carry it through by force account.

PROMOTION OF IMPROVEMENTS

The urge for more and better highways will persist for many years, and an important function of the technical organization is to set up programs of improvement whereby the department will be enabled to take care of the most pressing improvements from year to year, but in the end achieve a connected system of roads each part of which is improved in a manner suitable to the traffic. The outlining of a state-wide, county-wide, or city-wide program of improvement to continue for a period of years, cannot be completed without political considerations being interjected, and any legislative body that would attempt the job would surely be subjecting itself to a world of trouble, and some of its members to certain political persecution. Occasionally, some legislature attempts the task and soon learns that it has

opened a political Pandora's box. In the end, the job is delegated to the highway department of the state or county and to the city engineer or public works department of a city. The reason is that the adoption of a program of highway construction involves engineering and economic problems rather than political ones, and any attempt to develop a program on any other than scientific lines is pretty likely to meet with public disapproval.

In a certain populous county surrounding a metropolis, the highway construction was administered by an elective board, through a very high-grade county engineer and his staff. This county engineer had been asked to prepare a construction program, which upon presentation appeared to suit none of the members of the county board. The engineer then invited the board to make up the program, since he, himself, appeared to be unable to do it to suit them. Their reply was, "We could not agree among ourselves in a year. We would never get finished, and, if we did, it would mean political suicide to some of us."

The first step in formulating a program of highway improvement is to group the highways in the system according to traffic density, so that the necessary type and design of improvement may be estimated. Where funds are to be had for the purpose, a state-wide traffic survey is made to determine the amount of traffic on each section of the trunk highway system. If this is not feasible, the relative amounts of traffic are estimated from reports furnished by district engineers, maintenance superintendents, and staff members who are familiar with the conditions. All of this work is usually carried out under rather close supervision from the chief engineer, but the actual work is assigned to any bureau that happens to be in position to handle it. When the traffic information is as nearly complete as can be obtained, a map is made up to show which roads should be of a high-type surface, which an intermediate- or low-type surface, and the width of each. This map and the tabulations of the data from it present the problem.

The next step is to estimate the total expenditure involved which includes three factors. The cost for construction can be estimated by applying average cost-per-mile rates based on the previous work under the jurisdiction of the department. The cost of maintenance likewise can be estimated from the department records. The cost of engineering and administrative overhead is usually calculated as a percentage of the total

expenditure for construction and maintenance. In this way the total expenditure will be determined with sufficient accuracy for the purpose.

At this stage it is usually time to ascertain whether the program is to be carried out by current funds over a period of years or whether bonds are to be issued to hasten the completion of the system. If current funds are to be used, the period required to complete the program can be estimated, but what is more to the point, the volume of work each year can be fixed in accordance with the income, and a tentative program set up for a period of years. Perhaps, only 1 year's work will be definitely outlined, but it will be of such a character and apportioned to the various sections of the highway system in such a way that the most heavily traveled sections will be cared for, and the roads so constructed will be of a type and design in harmony with any logical plan of future development. The amount of work planned for each year of the period for which the program is outlined will depend upon the funds to be made available as estimated from the known sources of income.

If it is decided to proceed on the bond-issue basis to hasten the completion of a state-wide system, which will require approval of the electors, whether it be a state, county, or municipality, the program will be made up on a basis of the amount of work it is desired to handle in a season, under the conditions prevailing. Several states have been able to reach a stage where from 600 to 1,000 miles of paved roads are completed each year.

Having fixed upon the amount of work that can be completed in a season, the next step is to select the exact sections of highway to be improved. In this selection several factors need to be taken into account. Naturally, the most urgent projects will be included so far as possible, and this is the first consideration in the selection. The ability of existing or projected plants to supply a sufficient daily volume of material to keep the work in progress at the desired rate is determined. It is undesirable to draw too heavily on a single gravel or stone plant. Sometimes the capacity of rail transportation is the determining factor. These and similar physical conditions will have some bearing on the selection of projects.

It is desirable to award contracts in units of such size that each will be a season's work for a typical outfit. These outfits vary in capacity quite a little in various districts, and the units of con-

struction will range from 120,000 to 225,000 square yards of 9-7-9 rural highway concrete pavement, or the equivalent thereof in the other high-type pavements. Of the intermediate and low-type surfaces, the unit may be 5 to 25 miles of rural highway or even more if it proves desirable.

Based on these various general considerations and the economic necessities of the case, a program of construction will be outlined for a period of 1 or more years. The organization of the engineering and inspection staff will then follow.

It is known that each party on location can be expected to complete surveys of 5 miles of road each week or, in city work, ½ mile of street per day. The number of survey parties needed to meet the schedule is then fixed. A squad of four designers and a squad leader can complete the design of 5 miles per week of average rural highway such as would be found in the prairie states, but generally can be counted on for about 3 miles per week. The conditions will fix this rate and the drafting-room staff can be assembled. A resident engineer will be required for each project of not to exceed 25 miles of high-type road, and inspectors in the number discussed earlier in this chapter. Thus, the inspection staff can be organized.

The foregoing is not intended as a handbook of organization, but rather as an explanation of some of the types of problems that arise in highway administration. It is intended to show how the technical phases of highway construction influence the administrative functions of a highway department and the general method of attack when specific programs are being set up.

The method of estimating the future financial resources of a highway department is illustrated in Fig. 13. In this instance the amortization of two bond issues, one of $60,000,000 and one of $100,000,000, is predicated upon certain assumptions with reference to vehicle-license fees, which are expected to furnish the income for carrying and retiring the two issues of bonds. It will be noted that the population of the state is first predicted by projecting forward the curve of population for the past 70 years. Next, an estimate is prepared of the saturation density, as one vehicle to each six of population. The income from license fees is next calculated at the average fee for the assumed population for the period of the financing. This gives the estimated income upon which the amortization of the bonds is predicted. The bond and interest payments are then superimposed on the income

diagram, and the result shows graphically the status of the financial situation at any time during the period covered by the diagram (see Fig. 9).

Great care must be exercised in building up a diagram of this kind, since the tendency is to be too optimistic as to the income

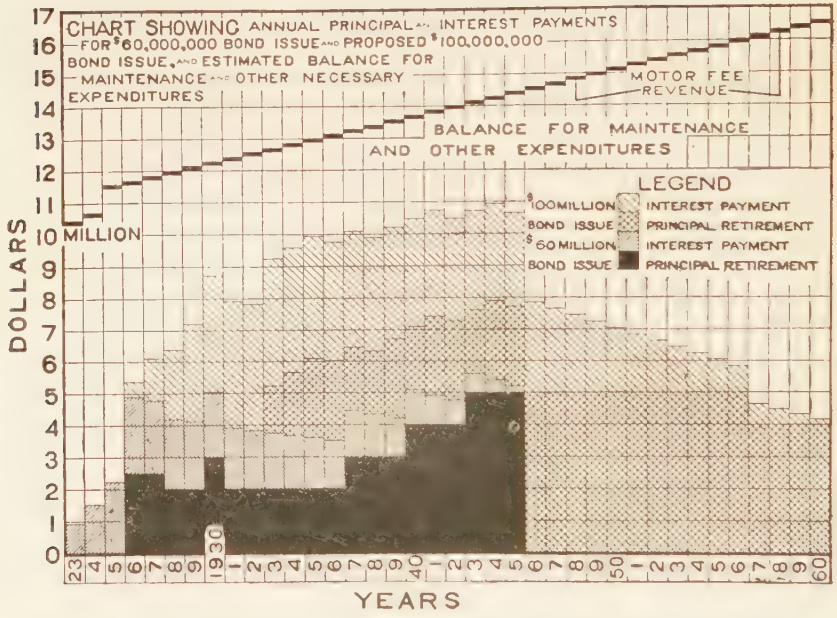

Fig. 13.—Showing financial analysis preliminary to inaugurating the Illinois Road Program.

that may be expected in the future; but the method is sound, and the only one adequate for an analysis of this sort. When the work is carried out under the supervision of an expert who knows how to avoid the pitfalls that are inherent in prognostications for periods far in the future, the results are the most dependable of any method so far developed.

CHAPTER XI

MUNICIPAL HIGHWAY DEPARTMENTS

The necessity for the care of municipal highways arose before much attention was devoted to the care of rural highways. At first the problem was quite simple, since the natural soil afforded the material with which the construction and maintenance forces had to deal. There has been little change in the nature of the problem to this day, so far as the villages are concerned; but at the other extreme is the great metropolis with hundreds of miles of surfaced streets and many miles with no surfacing other than the natural soil. Over the streets of the metropolis rolls an enormous tonnage of traffic of a type which is most destructive of roadway surfaces. Between these extremes, the village and metropolis, are cities of every intermediate size and type. Population, topography, industrial development, and climate contribute to the problem created by the fundamental need of providing a trackway for traffic.

Traffic Problems.—In the great cities, the downtown streets are a tangle of traffic through which vehicles of every description worm their way. Pedestrians dart through the maze, whistles shriek, horns blare, brake bands squeal and smoke. It is a nerve-racking, time-consuming ordeal to traverse the streets, either a-foot or a-wheel. Untold millions of dollars have been expended to provide for this traffic, and greater millions must be spent before there have been evolved adequate solutions to the many difficulties presented in the urban traffic problem.

It is well to consider what the cities are doing to develop an orderly and scientific improvement of the situation and to maintain the toll exacted in taxes to the lowest possible sum that will provide adequate transportation.

In those early days when there was no traffic problem, the municipal government consisted of a mayor and a town council or board of aldermen, each member of which represented a district or ward of the city. The mayor appointed a street commissioner who supervised the maintenance of the streets, employ-

ing for the work laborers recommended by the various aldermen. Sometimes, it was good labor, and at other times, not so good. When projects required accurate grades or levels, a surveyor was employed. He and his assistant drove a number of little stakes with curious characters marked thereon. The commissioner tried to conform to the lines and levels so established, and succeeded more or less, depending upon his aptitude at deciphering puzzles. For he seldom comprehended the significance of the survey stakes, although he may have had some hazy idea as to the general scheme.

Pavement Problems.—As the requirements of city traffic became more exacting, better types of pavements had to be constructed. These could not be properly laid without continued engineering services. The surveyor became the city engineer, devoting all his time to the duties that were assigned in connection with public improvements. The position of city engineer originated as a subordinate one in the street department, the duties being those of a surveyor, and in many cities has continued as such to the present day. The position is characterized by relatively low pay, lack of authority to enforce good standards of construction, and a total failure to recognize that the construction of modern pavements requires technical skill of a high order.

Evolution of Administration.—Meanwhile, the general system of administration of municipal improvements in the larger cities has undergone important changes. The amount of construction to be carried out each year has increased to such an extent that continuous administrative activity is required. The board of aldermen and the mayor could not possibly care for the routine of administration, so a street bureau of some kind made its appearance in many cities. The mayor and aldermen still retained control through the power of appointment. All of the major positions were filled by appointments, usually made by the mayor and approved by the board of aldermen, and even casual contact with the organizations thus set up will convince one that qualifications for particular duty plays little part in the appointment.

In many cities there was created a department of public works to which was delegated the responsibility for all construction work that was financed from public funds. The street bureau became a subordinate division of the department of public works. Then the street work was split up into bureaus, which were

respectively charged with the supervision of the construction of new pavements, the cleaning of streets, and the repair of streets. This is illustrated by the organization shown by Fig. 14.

Technical Staff.—In all this evolution, there was no great change in the status of the technical staff, which remained submerged in an organization that was directed largely by appointees who owed their position to political preferment. In a few cases engineers were selected to head important bureaus, but this was generally due more to the political astuteness of the individual than to any recognition of the increasing importance of technical supervision of the design, construction, and repair of pavements. Subordinate positions are on a better plane in many cities, because appointment is made through some civil service method.

Politics.—The following abstracts from the report of the director of public works of a great city, will illustrate a situation that too often prevails.

We had one bureau chief who, so far as we could find out after a diligent search continued over months, was not allowed to affect the work entrusted to him one iota during a long period of years in which he held his position. There is nothing to show that he had either the desire or the ability to do so. There was another chief in nominal charge of a very important bureau who, whether he knew it or not, was not allowed at times to see those who called on him, to open his mail, or answer telephone calls. The depressing effect, especially on capable and high-spirited men, of a system of this kind was everywhere visible when we came into office. On every hand we found demoralized and broken lives. It was almost an everyday occurence for those highest in the city service to use their official position and political power to order conscientious inspectors off contract work where, owing to the way in which they had sought to safeguard the interests of the city, they had become obnoxious to contractors with political influence; and, then, to order in their places other and more complacent inspectors named by the contractors themselves.

A few instances from among many illustrating the type of individuals formerly carried on the roll of the highway bureau will be illuminating:

The writer received a suggestion from a well-known gentleman of international reputation that a certain highway inspector made his living largely by running a policy game, and that he had already served a term in jail. I sent for him and peremptorily asked him to resign. He asked me whether I was sure I had the right man, as there was another man by his name from the ward in which he lived. Upon being assured that there was no mistake, he promptly signed his resigna-

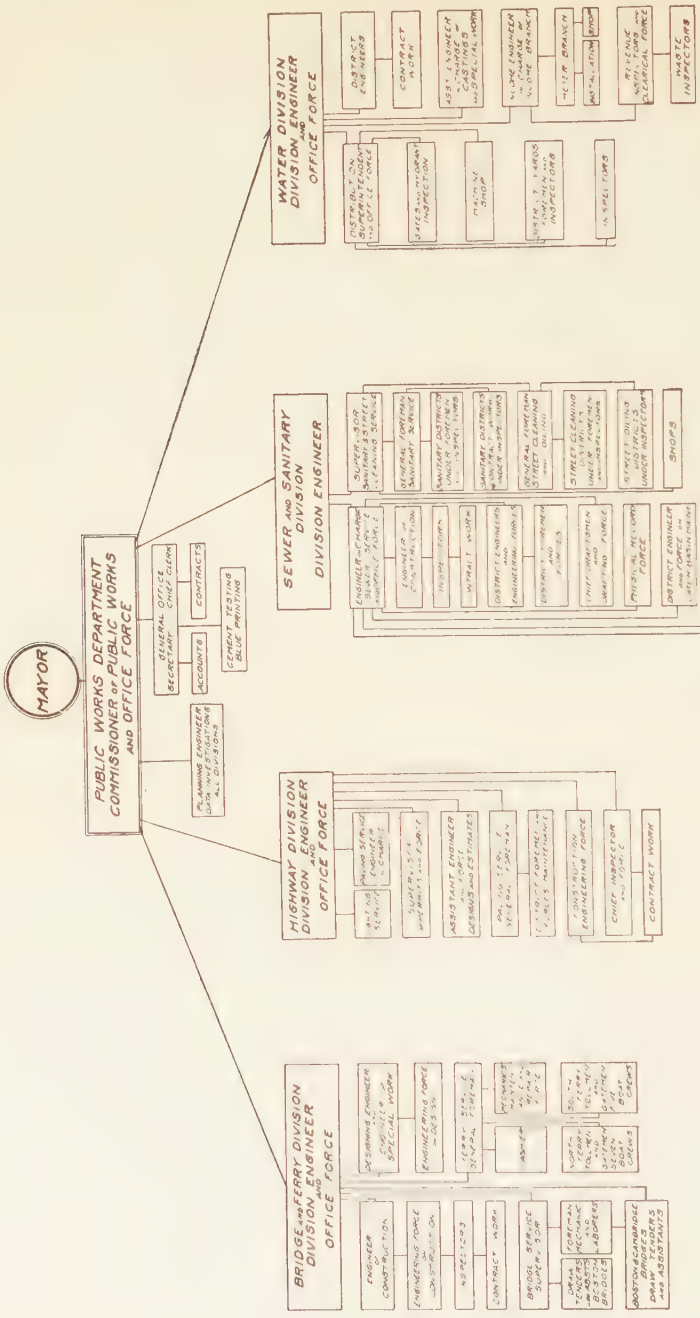
MAYOR
PUBLIC WORKS DEPARTMENT
COMMISSIONER OF PUBLIC WORKS
AND OFFICE FORCE
GENERAL OFFICE
SECRETARY
CHIEF CLERK
ACCOUNTS
CONTRACTS
CEMENT TESTING
BLUE PRINTING
PLANNING ENGINEER
CONSULTING WORK
ALL DIVISIONS
BRIDGE AND FERRY DIVISION
DIVISION ENGINEER
OFFICE FORCE
ENGINEER CONSTRUCTION
ENGINEERING FORCE CONSTRUCTION
INSPECTORS
CONTRACT WORK
BRIDGE SERVICE SUPERINTENDENT
DRAW TENDERS AND ASSISTANTS
FOREMAN MECHANIC BOSTON BRIDGE
LABORERS
BOSTON & CAMBRIDGE DRAW TENDERS AND ASSISTANTS
DESIGNING ENGINEER SPECIAL WORK
ENGINEERING FORCE
ASSIST. ENGINEER
ASSIST. ENGINEER
MECHANICS
LABORERS
FOREMAN
MECHANICS
LABORERS
BOAT CREWS
HIGHWAY DIVISION
DIVISION ENGINEER
OFFICE FORCE
ASSIST. ENGINEER
DESIGNS AND ESTIMATES
ENGINEERING FORCE
CHIEF INSPECTOR
AND FORCE
CONTRACT WORK
SEWER AND SANITARY
DIVISION
DIVISION ENGINEER
ENGINEER-IN-CHARGE
SEWER WORK
ENGINEER OF CONSTRUCTION
INSPECTION
INSPECTORS
WHALE WORK
DISTRICT ENGINEERS
ENGINEERING FORCES
DISTRICT FOREMEN AND LABORERS
PHYSICAL RECORDS FORCE
SUPERINTENDENT SANITARY SEWERAGE
GENERAL FOREMAN SANITARY SEWERAGE
SANITARY DISTRICTS UNDER FOREMEN
SANITARY DISTRICTS UNDER INSPECTORS
GENERAL FOREMAN STREET CLEANING
STREET CLEANING DISTRICTS UNDER FOREMEN
STREET CLEANING DISTRICTS UNDER INSPECTORS
SHOPS
DISTRICT ENGINEER AND FORCE ON SPECIAL WORK
PUMPING STATIONS
PUMPING ENGINEERS
MOUNTFIELAND FRESH POND FOREMAN AND FORCE
WATER DIVISION
DIVISION ENGINEER
OFFICE FORCE
DISTRICT ENGINEERS AND OFFICE FORCE
DISTRICTS
CONTRACT WORK
ASST. ENGINEER IN CHARGE OF CASTINGS AND CONSTRUCTION
METER BRANCH
INSTALLATION
REPAIRS
METER INSPECTORS
MAIN ENGINEER IN CHARGE OF MAINS
METER BRANCH
INSTALLATION
REPAIRS
METER INSPECTORS
PIPE LINE WORK FOREMEN AND ELECTRICAL FORCE
WASTE INSPECTORS
DISTRICT OR DIVISION ENGINEERS AND OFFICE FORCE
JUNCTION AND INSPECTION
MACHINE SHOP
WATER WORKS INSPECTORS
INSPECTORS

Fig. 14.

tion and rushed out of the room. In a few hours I heard he had beaten up a politician in a nearby saloon on the theory that he had been instrumental in losing him his place, and been arrested therefor.

I asked another man to resign and he demurred, asking my reason. I told him that when a man resigned it was not necessary to tell him why; that if he refused to resign I would discharge him and then be, by law, compelled to disclose the cause. He seemed, however, so insistent to know, that I told him he was inefficient. Replying, "Oh! Is that so?" he took up the pen and signed the resignation blank. Then looking at me with a curious quizzical glance, he said, "See here, Director, there is something wrong about this. I never had anything to do; so how do you know I am inefficient?" The point, although well made, was made too tardily.

The smaller cities have modified their administrative system but slightly, because the need has not yet made itself felt to the public and perhaps that need never will be recognized from the public improvement standpoint.

Growth of Municipal Engineering.—Broadly speaking, the evolution of types of roadway surface that has resulted in the general adoption of technical supervision for rural highway construction has tended in the same direction in the cities, but the effects have been much less marked. The technical staff of the city is too often submerged in an organization that is to a large extent manned by appointees who will not recognize the contribution of technical experts. It is doubtful if the cities realize that they are not keeping pace with the progress of the times in the matter of highway administration. This is merely one phase of that outstanding political problem of the hour in the United States which is how to devise a better system of city government, a problem that will be solved only when the public can be made to realize the defects that now exist, and that will require much effort.

Forms of City Government.—Two noteworthy advances have been made during this generation—one, the development of the commission form of city government, which was an accidental outgrowth of the Galveston disaster; the other, and more recent, the establishment of the city-manager plan of municipal government. When these are adopted by a city, it usually means an improvement in the status of the technical staff of the street department.

The outstanding need of cities of all sizes is a greater appreciation of the technical nature of most of the work connected with

the construction and maintenance of pavements, sidewalks, and the structures incidental thereto. The failure to sense this situation is responsible for a tremendous economic loss each year through the adoption of unwise street improvement policies.

Bidding for Engineering Jobs.—The cities that are so small that they do not need and could not support a full-time city engineer, must depend upon consulting service when pavements are to be constructed. Many individuals and engineering firms are engaged in this service. As might be expected, some conduct their consulting service on a high plane, while others, under the stress of competition, are inclined to resort to doubtful practices. This is aggravated by the policy, current in many towns, of employing technical service on a basis of competitive proposals. If these proposals were based on specifications as to service, perhaps some of the objectionable phases of the method might disappear. The usual procedure in the small town is for the town council to invite proposals for performing the engineering work in connection with contemplated projects. A number of engineers will meet the council on the day assigned and submit verbal proposals for the work, usually in terms of a percentage of the sum involved in the construction. No definite contract as to the actual service to be rendered is ever provided. The inevitable result is that the less experienced and more needy men really set the standard of compensation and the character of service rendered. The town loses in quality of construction far more than it saves in consulting fees. The remedy lies in the engineer's hands. He should not enter into this type of competition for work.

County Consolidation.—There is reason to hope that at an opportune time all of the engineering work in a county, including that in the cities that do not have a resident engineer, will be consolidated in the office of the county engineer who will have charge of the highway work on the county and township roads, the street work in the villages, and the sanitary and drainage work not under the control of the resident engineers. If a town undertook construction requiring resident supervision, the county engineer would supply a resident engineer for the duration of the project. Such a system would undoubtedly result in a great improvement in the quality of the public improvements in the small cities as a similar system has in England.

Duties of Municipal Highway Departments.—A proper conception of the functions of the technical staff in a municipal highway department may be gained by considering the kinds of things that are to be done. The more important are the following:

1. To make surveys and prepare plans and specifications for the construction of pavements, sidewalks, and street accessories.
2. To inspect the construction of pavements, sidewalks, and appurtenances.
3. To test the materials that enter into street structures.
4. To supervise the maintenance of pavements.
5. To assist in the formulation of regulations to govern street traffic.
6. To conduct investigations of the volume and distribution of traffic on the streets.
7. To prosecute research in the use of materials and the behavior of various pavements when under traffic.

Routine Engineering Work.—It is the general custom to depend upon the technical staff for surveys, plans and specifications for new construction. Work of this kind is recognized as engineering and outside the province of any branch of the non-technical organization of a street bureau. The engineering work incident to these activities has been well done as a general rule, but many cities fail to support a personnel that is large enough to insure the thorough analysis of every new project. In many cases the engineering staff is also handicapped because the records of previous work are not complete or have not been filed and indexed in such a way that they can be consulted. Revision of standard plans and specifications is too frequently delayed by the necessity for securing approval from non-technical administrators, who are likely to be suspicious of every proposed change in the established order of things and withhold approval for trivial reasons.

The selection of the type of pavement is rarely based on the recommendations of the technical staff; indeed, the administration rarely seeks technical advice on the subject, and, hence, new pavements of a wholly inadequate type are very often ordered. It is in this connection that the cities have overlooked the greatest opportunity to effect economies.

Inspection.—The inspection of new construction is rarely entrusted to the technical staff, although some general supervision of inspection is delegated to them. Somehow, there has

developed the custom of employing what are erroneously called "practical construction men" for the inspection of pavement construction. In few cities is this inspection even tolerably good and on the average it is wholly inadequate. In this respect another great opportunity is presented for conserving public funds. The inspection of pavements always should be strictly technical, which means that on each contract there should be a resident engineer in full charge of all phases of the inspection. Some of the inspectors would be technical men, while skilled non-technical ones might be used under engineering direction for other parts of the job. The cost of the right kind of inspection is a trifle compared with the resulting improved quality of the pavements.

Testing.—Materials testing of a thoroughgoing character has been growing in importance with the increasing severity of the destructive effects of traffic. The cities are gradually realizing this and are giving more and more attention to the subject. Testing laboratories are being equipped and manned with technical experts, so that this phase of the problem is in a healthy state of growth. Many commercial laboratories are being operated, and the city that has no laboratory of its own may secure dependable materials-testing service at a moderate cost. It seems to be generally agreed that when the volume of construction is large, it is wise for the city to operate its own testing laboratories, even though no financial saving results, because of the greater facility with which tests can be handled and the closer coordination of the testing with the inspection of construction.

There is also more than a suspicion that some of the commercial laboratories are forced, by competitive conditions, to conduct their testing in such a manner as will avoid making enemies among constructors and materials-supply companies. Unfortunately, there is little difficulty in accomplishing this, because city officials, in general, understand the reports on tests about as well as they do Sanskrit.

Maintenance. The maintenance of pavements, while they are in service, involves about the same technical problems as does the construction of new pavements. This is recognized by few cities, and the repair work is carried out with little or no technical supervision. In rare instances does it appear that any systematic effort is made to ascertain when pavements have reached their

economic life, or to calculate the maintenance cost of various types of pavements in terms of the traffic service rendered. Methods and equipment employed for repair work are antiquated and inefficient. Too great emphasis cannot be placed on the need for the closest supervision of pavement maintenance, to the end that the work be executed properly with the very best materials and by the most economical methods.

Traffic Regulation.—Traffic regulation has grown in importance along with the other problems incident to present-day traffic. Methods of regulation are still somewhat haphazard and largely experimental. A long period of evolution will be likely to elapse before anything approaching a standard system of traffic control can be devised. Some of the phases of traffic control must of necessity be developed by the police department of a city, because law-enforcement officers will best understand the requirements. Other phases of regulation will arise out of the necessity for protecting the pavements, and the restrictions necessary naturally will be first apparent to the technical staff of a street department. They can and should contribute to the preparation of the traffic code for a city.

Research.—In industry and in the technical fields, research and investigation are being used more and more to advance the boundaries of knowledge. Many noteworthy researches in subjects related to highway construction have been completed in recent years and these have given added assurance to those who must design roadway surfaces. Whether or not it be able to carry out major researches, a municipal highway department will always have some minor problem under investigation. If major researches are needed and can be carried out, that is still better. It is by means of painstaking research that the knowledge will be secured whereby the most serviceable pavements of every type can be built. This is an important function of the technical organization.

Effective Organization.—A review of the results obtained in a number of large cities seems to indicate that all work having to do with the care of streets should be administered by a single bureau or department. This bureau may be organized as a part of a department of public works, or may be an independent bureau reporting to the mayor and board of aldermen. Probably all cities having a population of 50,000 or over can profit by handling street work through a special bureau of some sort. For

the smaller cities, the street work may be consolidated with the other engineering work of the city under the city engineer. The problem is difficult to solve for the villages, and no system as yet attempted in the United States is really satisfactory.

In the street bureau of a large city the work will naturally fall into five divisions such as construction, maintenance, cleaning, materials testing, and statistical. At the head of each division, except street cleaning, there should be a technical expert. At the head of the bureau of street cleaning, there should be a good executive, because work of that type is exceedingly difficult to administer and the technical problems are minor.

The function of the construction division would be to prepare plans and specifications for new work and to inspect all work while under construction.

The general office and statistical division would prepare the notices for the use of the clerk in calling for bids for proposed construction, keep a record of bids received, and of the progress of construction. It would make up estimates for payment of completed contracts, supervise the preparation of assessments rolls, and maintain records of the life history of each pavement and of the expenditures for maintenance. The office division would serve to correlate the activities of the other divisions and pass on to them the records of work authorized by the board of aldermen.

The maintenance division would organize and supervise the work of maintenance gangs, develop maintenance methods, and inspect the maintenance operations conducted under contracts. Permits for pavement openings desired to afford access to underground services also would be issued by this division, and the replacement of these openings would be inspected before releasing the permit holder from bond.

In the smaller cities, the five major functions that were listed for the larger cities will be exercised without a division of the city engineer's organization. The city engineer and his assistants will take care of the various kinds of work as they arise, except that the materials testing in many cases will be performed by a commercial laboratory. A city engineer, even in the smaller municipalities, should have one assistant whose principal duty is to keep complete office records of all data pertaining to the engineering work of the city. The situation that exists in many small cities is well illustrated by the following extract.[1]

[1] *Eng. News-Record*, p. 381, Sept. 3, 1925.

There is one old man in —— who assisted in the laying of the old sewer lines. His memory is good but his health is not. From him there is known that there are something like 200 sewer dead ends in the city. Their approximate location is also known. So the city engineer got this aged resident to go with him to that location. A cross ditch was dug. If the sewer line were found, a cleaning rod was run into the sewer until it could be pushed no farther. That length of sewer cleaning rod was then measured on the ground and at its end a hole was dug, the dead end found, and a manhole was put in. Should this one resident die, it is obvious that the job of the city engineer is greatly complicated.

Expert Opinion.—The status of engineering work in the small cities was studied at some length by an editor of the *Engineering News-Record* in 1925-1926, and his observations are summarized as follows.[1]

Foremost among these, it has been found that the position of the engineer in the government structure is, more often than not, belittled. Scarcely ever is the position of city engineer on a parity with that of other administrative officers in the city government. He is appointed by a city manager, a commissioner of public works, a mayor, a council committee (which usually is a single individual), and his tenure of office, like all the other elective and appointive officers of most American cities, is apt to depend upon the success of a particular political party. This condition points to three needs:

1. Education of the public to the necessity for giving engineering and its representatives in the city government their deserved responsible position.
2. Freedom of engineering service from political influence.
3. Continuity of service for engineers to give to engineers' work greater efficiency in construction, operation, and maintenance.

Let it be early understood that we are not concerned here with the city engineer in name. The object of our study is referred to as such, but he represents that government officer to whom has been delegated administration of civil engineering affairs.

To make the duties of the city engineer plainer, a chart is herewith reproduced (see Fig. 15). As stated, the city engineer should be the supervisor of all engineering functions. His control over design and construction of paving, sewers, sidewalks, curbs, and gutters—which incidentally comprise his chief duties—is through two assistant engineers who are directly responsible for the work. He should have such supervision over maintenance that any questions involving technical knowlege should be referred to him by the superintendent of maintenance. Most of the maintenance work, however, can be carried on easily without any

[1] *Eng. News-Record*, p. 76, Jan. 14, 1926.

but the most casual sort of supervision from the city engineer. In some cities where street patching, curb replacement, sewer cleaning, etc., do not take up too much of the time of the maintenance superintendent, that individual could also supervise street cleaning and garbage disposal. In larger communities, it may be necessary to employ separate men for these jobs.

It may clarify this part of our discussion to state that the city engineer may be considered as head of the department of engineering, with the separate services in his control—where their number, importance, and the size of the city warrant—under bureau chiefs. Where the local municipal scheme of organization includes a department of public works, it may be expedient to have the title city engineer give way to chief engineer, department of public works. Or better, to consider, as is

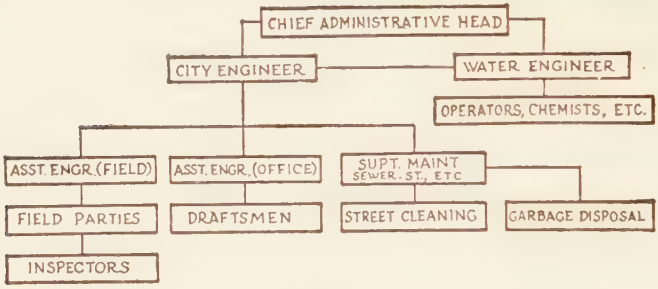

FIG. 15.

the case in many city-manager cities, all engineering work concentrated under a director of public works or utilities, who may or may not be the city engineer, but who should be a technical man.

Right here it should be said, further to emphasize the fact that we are dealing with the man who does the engineering work, rather than the title "city engineer," that in numerous instances the city engineer is little more than a surveyor. Technical details are divided among a number of bureau chiefs, so that the city engineer has little more technical authority than several lay superintendents. If this division is to be made, undoubtedly the director of public works should be an engineer, for if he is not, there is bound to be incomplete, if not incompetent, administration of certain engineering functions.

Initiating Improvements.—Several legal methods of inaugurating street improvements are extant in the states, and one of them that is common to all provides that under certain conditions the board of aldermen may start the necessary legal procedure. In addition, property owners may petition for pavements on their

street. By far the greater portion of the paving projects are initiated by official acts of the board of aldermen. The usual method is for the alderman of a ward to ascertain what new work should be undertaken in his ward, which he does in various ways. Residents of the ward will sometimes make informal request for the pavement of certain streets. Individuals, clubs, and commercial organizations may suggest the desirability of certain improvements. The several aldermen then present the needs of their wards at a meeting of the board. The bureau of streets or the city engineer may also submit a list of the projects that are deemed necessary. From these various suggestions, a program of street improvement is worked out. Some cities operate on a program that has been made out to cover a period of several years, and this is reviewed each year with the idea of modifying it as conditions demand. The procedure after the program has been determined varies within the several states according to the system established by the law. Certain official publications and hearings are generally required, and these are usually cared for by the legal department of the city.

At the proper time the engineering department is notified to prepare plans and specifications for each project. Sometimes, the type of pavement has been determined by the board of aldermen before proposals are invited, in which case the plans and specifications will cover the type selected. The selection is made officially by the board of aldermen, who may be guided by the wishes of the property owners affected, but in any case will exercise their own discretion as to types of improvement to be authorized. Sometimes, the engineering department is asked for recommendations, and, often, it is not.

The plans and specifications are prepared by the engineering department, presented to the council, and adopted as an ordinance or by resolution. The city clerk then advertises for proposals, and in due time a contract is awarded by the board of aldermen. The engineering department is notified when the constructor expects to start operations. At this stage the engineering department assumes supervision of the work in so far as the system provides for technical supervision. When the work is completed, the engineering department files with the board of aldermen a certificate of completion in which is included a statement of the several items of the contract and the total sum due the constructor. This certificate is approved by the board and

the statement is the basis for any special assessments that are to be levied on account of the work.

Summary.—The functions of a municipal highway department have been outlined to show the present practice of the cities of the United States. A considerable number of the larger cities have competent and effective engineering organizations that are functioning smoothly and producing street improvements of a high degree of excellence. The same is true of some of the cities of intermediate size and of a few small cities.

Too many municipalities of all sizes, and especially the smaller ones, have failed to provide themselves with anything approaching an adequate highway department.

CHAPTER XII

ORGANIZATION AND ADMINISTRATION OF CONSTRUCTION

In the discussion of construction organization it will be convenient to employ certain terms that are widely used in the construction industry, and to avoid confusion the terms are defined in accordance with the ordinary usage.

Contract Work.—The term "contract work" is commonly applied to construction that is performed by a person, firm, or corporation for a compensation established by agreement, usually after competitive bids have been received by the owner.

Lump sum contracts are those in which a fixed sum has been agreed upon for performing all the various classes of work required to complete a specified piece of construction.

Unit price contracts are those in which a price has been agreed upon for each unit of each kind of work involved in a specified job.

Cost-plus contracts are those in which the work is performed at cost, plus a percentage of that cost, or plus a fixed sum.

Force-account or day-labor construction is work that is performed by forces employed directly by the owner and supervised by his agent.

Constructor (Contractor).—The term "constructor" is employed in preference to the more common, but less accurate, term "contractor" to designate a person, firm, or corporation whose business is the execution of construction work.

ELEMENTS OF CONSTRUCTION ORGANIZATION

The organization employed for the construction of highways includes not only the working forces and mechanical equipment that is actually to be seen on the job, but also the office and managerial personnel, whose contribution to the project is less obvious. In a constructor's business, the personnel includes a staff for preparing proposals and presenting them at public lettings, arranging the financial details in connection with conducting the business, checking the legal status of proposed con-

tracts, and for cost keeping, accounting, purchasing, and correspondence, in addition to the field forces actually engaged in the construction. The number of persons required for these several functions is dependent upon the magnitude of the constructor's business. It is not uncommon for an individual to perform all the office and managerial work himself, and of such it is said that "he carries his office under his hat." At the other extreme is the corporation that operates nationally or internationally with many large contracts under construction at all times.

Construction may be organized by the governing body of some political unit, such as the township, county, state, or municipality, although in general these bodies are not in the construction business. When they do undertake highway construction by force account, some of the units of organization mentioned above might not be employed. Ordinarily it would not be necessary to prepare proposals, or to make financial provision beyond that prescribed by law before public funds could be utilized. Generally, an estimate of cost would be prepared, but it would not be so complete or so detailed as that required in preparing a proposal for contract work.

In this discussion of construction organization, it is proposed to deal but briefly with the office or headquarters organization, since its form and magnitude are dependent upon many factors outside the province of this treatise. The principles of job organization, however, are reasonably clearly defined, and apply quite generally to all classes of highway construction.

Project Analysis.—One of the functions of the general office organization is to make an analysis of a proposed piece of construction to determine how the job shall be organized and equipped. This is sometimes worked out as the first step in the preparation of an estimate of cost preliminary to the submission of a proposal, and at other times is developed as the proposal is being prepared. When prepared for force-account work, the analysis is a preliminary to the organization of construction operations. In all cases, the project analysis, under whatever guise it may be performed, constitutes the first and the most important preliminary to the organization for construction.

A project analysis is made by separating the work into basic operations, each of which constitutes a complete, independent, process that can be organized as a distinct unit to be supervised by one foreman; or it might be performed by a subcontractor.

An analysis of this character is made by a person who is familiar with construction practice and who is capable of determining what departures from the usual methods may be advantageous for the work under consideration. Project analysis should not be confused with operations analysis, which has for its purpose the selection of equipment and the establishment of the exact procedure each foreman shall adopt.

It is unlikely that all constructors would analyze an involved piece of work in exactly the same way, although they would probably arrive at approximately the same elementary operations. The ultimate aim of project analysis is to enable the management to organize construction, so that it can be performed at the minimum cost consistent with completion within the time specified and the most economical ultilization of the mechanical equipment available.

To illustrate a typical project analysis, let it be assumed that it is proposed to construct an asphaltic-concrete pavement with a concrete base. The basic operations are shown in the following list, and each ordinarily would be carried out under a foreman responsible directly to the general superintendent.

1. Earth work:
   - *a.* Rough grading.
   - *b.* Preparation of subgrade for pavement base.
   - *c.* Trimming shoulders or side berms after the completion of the pavement.
2. Transportation:
   - *a.* Of concrete materials or concrete.
   - *b.* Of asphaltic-concrete surface mixture.
   - *c.* Of forms and miscellaneous supplies and materials.
3. Mixing concrete:
   - *a.* Unloading and storing materials.
   - *b.* Proportioning materials.
   - *c.* Mixing.
4. Placing concrete:
   - *a.* Spreading, tamping, and shaping.
   - *b.* Construction of marginal curbs.
   - *c.* Curing.
5. Mixing asphaltic concrete:
   - *a.* Unloading and storing materials.
   - *b.* Operating mixing plant.

6. Water supply:
   a. Development of source.
   b. Distribution.
7. Placing asphaltic concrete:
   a. Spreading and raking.
   b. Rolling.
   c. Applying seal coat.
8. Accounting:
   a. Labor payrolls and salaries.
   b. Materials, freight, and supply bills.
   c. Allocation of general overhead.
9. Progress and unit cost records for each element of the construction.

The foregoing illustrates the project analysis for one of the more complicated types of highway construction, while the following analysis of a gravel-road project will illustrate one of the simpler problems:

1. Earthwork:
   a. Rough grading.
   b. Shaping roadbed for the gravel.
2. Gravel pit operation:
   a. Stripping.
   b. Excavating, crushing, and screening the gravel.
   c. Loading on transport.
3. Transportation.
4. Placing and spreading gravel surface.
5. Accounting:
   a. Labor payrolls and salaries.
   b. Allocation of general overhead.
   c. Material and supply bills.
6. Progress and unit cost records.

Operations Analysis. Having listed the typical subdivisions of a construction job, it is next in order to study each division of the work with a view to determining the elementary operations involved therein and the most economical procedure, in view of the conditions that exist on the job under consideration. In general, this sort of study is more or less informal and, in fact, is often made almost unconsciously by experienced constructors. Much can be said in favor of a tabulated study and a review thereof by several members of the staff of a construction organi-

zation, in the interest of thoroughness and accuracy. The record of such a study, moreover, will be a valuable guide for superintendents and foremen.

In a preceding section, rough grading was listed as one of the typical subdivisions of the construction of a highway. This operation may be analyzed with a view to determining the elementary operations involved; whereupon, the method of construction and type of equipment best adapted to the particular job may be selected.

The elementary operations are:

1. Loosening the material so that it can be moved.
2. Loading the material for transportation.
3. Transporting the material to place of deposit.
4. Depositing and shaping material to place in embankment.
5. Compacting the embankment.
6. Final smoothing of embankment.

In a typical job of rough grading, the above operations might be performed as follows:

1. The material loosened by plowing, requiring a team and driver and one plowman.

2. The material loaded into a wheel scraper, requiring an extra team and driver to help load ("snatch" team or "snap" team) and one or two men to handle the scraper while it is being loaded (one man when the soil is light and loose, two men for heavy, lumpy, or wet material).

3. The material transported by the wheel scraper into which it was loaded, requiring a team and driver.

4. The material deposited by dumping the wheel scraper at the proper place to give the approximate shape to the embankment, requiring one man.

The embankment is then further shaped with a broad, flat scraper ("marmon"), requiring a team and driver and one man to operate the scraper.

5. In exceptional cases, it is required that the embankment be constructed in layers or "lifts," each of which is rolled. This requires a self-propelled roller and an operator.

6. The final shaping and smoothing of the embankment is performed by a light blade grader, requiring two teams and a driver and one man to operate the grader.

Good management demands a nice adjustment of the several units outlined above, to the end that each operation will be

performed at the lowest possible cost per unit of output. The method employed for accomplishing this will be discussed in another place.

The foregoing outline presents a typical rough-grading method, but not by any means the only one that is ever employed. For example, the operations of loosening and loading may be combined by using the elevating grader. Transportation then will be by means of dump wagons and the other operations will be as described. A power shovel of some type may be used for loosening and loading the material, and dump wagons or dump cars for transportation. In shale or rock the loosening may be by blasting and the loading by means of a power shovel. It is conceivable that labor conditions might prevail (as they do in many countries) where the loosening and loading would be performed by hand tools, the transportation by hand barrows, or packs, and the depositing and smoothing by hand labor.

The first problem of organization is to select the combination of unit operations best adapted to the conditions, which means that they are calculated to give the lowest unit cost consistent with completion within the time allowed.

Another unit operation is the shaping of a natural road surface to the form prescribed, before a new wearing surface is constructed thereon. While this operation is involved in the construction of all kinds of road surfaces, the requirements are most rigid in connection with the preparation of the subgrade for the types of roadway surfaces involving the use of asphaltic concrete or portland cement concrete. The shaping of the roadbed for these types is usually called "fine grading" or "subgrading."

The elementary operations involved are four in number.

1. Loosening the excess material down to the elevation of subgrade, usually with a tolerance not to exceed ½ inch.
2. Removing the loosened material.
3. Backfilling when the subgrade is too low.
4. Compacting the loose material of the subgrade.

Typical methods of performing these operations for street pavements would be as follows:

1. Loosen excess material by means of hand tools, such as the spade, pick, or mattock.
2. Remove the loosened material with hand shovels.
3. Fill low places with excess material removed from high places or hauled in for the purpose, using hand shovels.

4. Compact by means of a self-propelled roller.

The only cost-saving expedients in connection with fine grading are: to be careful in finishing the rough grading so as to minimize the amount of material to be handled in the fine grading; and to provide hand tools that are suitable for the material that is to be handled.

In the performance of fine grading for narrow roadways, such as are common on rural highways, a subgrade shaping machine can be used to loosen the material for removal and to drag loose material into the places that are too low, but excess material is removed with hands shovels.

The elementary operations involved in transportation, where mechanical equipment is employed are as follows:

1. Loading.
2. Dispatching.
3. Unloading.
4. Routine servicing.
5. Emergency servicing.

Loading equipment is properly a part of that employed for proportioning or mixing in the case of concrete and asphalt work, but for other kinds of materials it must be organized by the transportation superintendent. The sequence of operations in loading any material, moreover, and the routing of the equipment must be planned carefully in order to keep costs to the minimum.

Unloading must be arranged so that other construction operations are not interrupted and the equipment is kept moving. In fact, the great profit devourer in highway construction is transportation equipment that is not in motion. Routine servicing is accomplished at night or at times when the job does not require the service of transportation. Emergency servicing is provided by various devices, such as specially equipped trucks that are held for that work; by repairmen who travel in automobiles carrying spare parts, or by the operators of the units of transportation who are furnished spare tires or spare parts with their equipment. The type of transportation selected must permit the delivery of the several materials at the rate and in the manner calculated to insure the completion of the work within the time specified, and deliver them at the minimum cost. In the usual highway construction project, the transportation equipment might be of one of the following types, or in special cases a combination of two of them:

1. Motor trucks.
2. Industrial railway.
3. Animal-drawn wagons.
4. Tractor-drawn trucks.

Of the first two named, many types and capacities are available.

The factors involved in the detailed analysis and organization of construction transportation is, perhaps, sufficiently well illustrated by the foregoing, but a complete detailed analysis of a construction project will be presented in another place.

PROGRESS DIAGRAMS

Contract construction is usually undertaken with the stipulation that the work will be completed within a prescribed length of time. The time fixed for performing the work should be based on some systematic study of the problem presented, unless the work is similar in character to projects that have already been carried out and for which complete information as to the time required is at hand.

For work of such a nature that the time required is not readily determined by reference to the records, a time study is made to estimate the length of time that should be allowed the constructor for completing the project. This is most readily and accurately accomplished by preparing an estimated-progress diagram.

When a constructor is developing the organization for a construction project, he must recognize that a rate of progress is to be provided which is adequate to complete the work within the time allowed and, if the project is of any magnitude, he will find the estimated-progress diagram to be of great assistance. As the work proceeds, the engineering staff responsible for the inspection, and the constructor, are both interested in knowing whether a rate of progress is being maintained that is adequate to insure completion within the time specified. This is most readily shown by an actual-progress diagram, which may be compared with the estimated-progress diagram for the project and thus the status of the work will be apparent at the end of each checking period.

Typical Forms of Progress Diagrams. – Progress diagrams are either in the form of graphs or of block lines, but the graph is considerably more common than the block-line type. Each, however, has its field of usefulness. The graph type of progress

diagram[1] is shown in Fig. 16. It will be noted that time intervals are shown along the lower margin of the sheet, and that the sheet is ruled with vertical lines, the space between which repre-

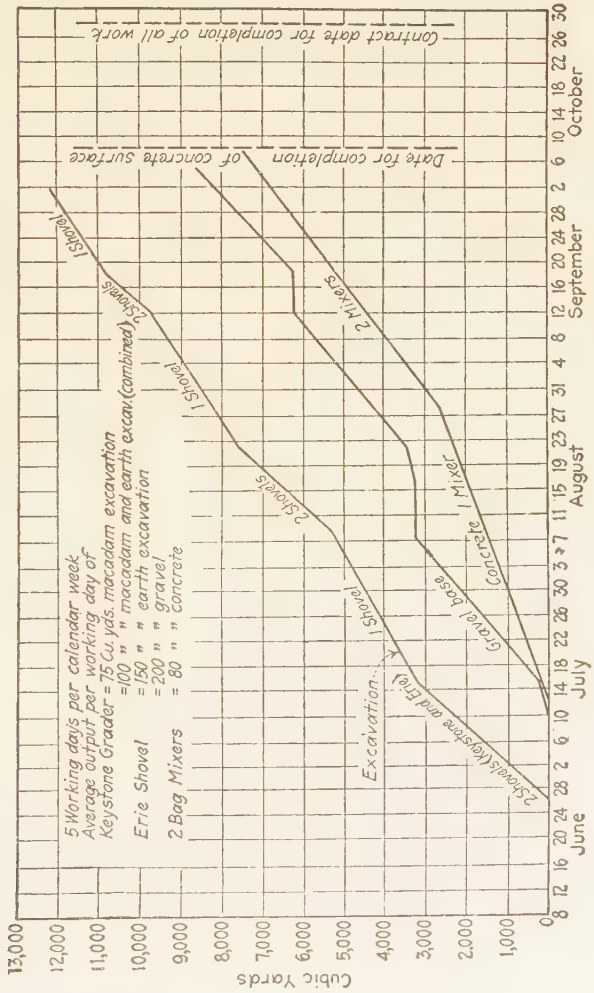

Fig. 16.—Graph type of progress diagram.

sents an interval of 1 week. In special cases this might be 1 day or 1 month, but for highway work the week is the preferred unit. Along the left margin of the sheet are shown the stations corresponding to those given on the plans for the project. Hori-

[1] Page, Austin E., *Eng. News-Record*, July 19, 1923.

zontal rulings are provided and the interval between any two of these represents a distance. In some cases the ordinates might better represent quantities instead of length.

The progress diagram for grading should show accomplishment in terms of cubic yards of excavation. In other cases the ordinates might represent percentages. The particular form selected

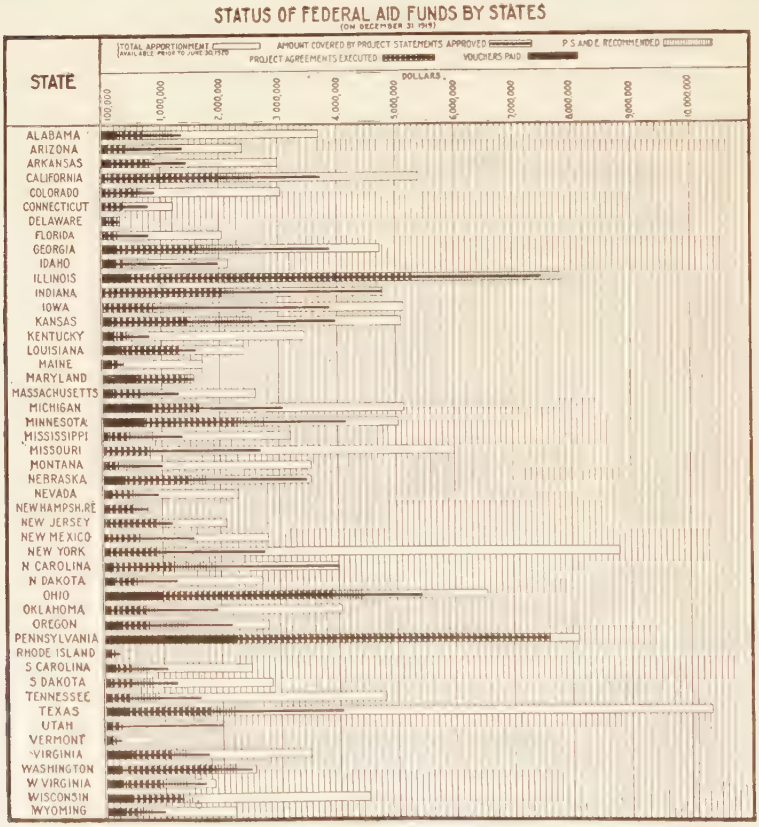

FIG. 17.—Block line type of progress diagram.

depends upon what is most convenient in checking the work for which the progress diagram has been prepared.

The block-line type of progress diagram[1] is shown in Fig. 17. Its construction is simple and apparent at a glance. This type is of little service in connection with organization problems, since

[1] *Public Roads*, p. 43, February, 1920.

it gives but little indication of the irregular variations in rate of progress during construction, but it does present a clear picture of the status of a piece of work at the end of each checking period. It is particularly useful for presenting general information to non-technical boards and to the public.

Estimated-progress Diagrams.—The form of progress diagram most useful in job organization is of the graph type with time intervals as abscissæ, shown by dates along the lower margin of the diagram; and quantities of work as ordinates, shown by survey stations or distances along the left margin. Lines drawn on the diagram show the proposed date of commencement of each major operation, contemplated rate of progress, and the time of completion.

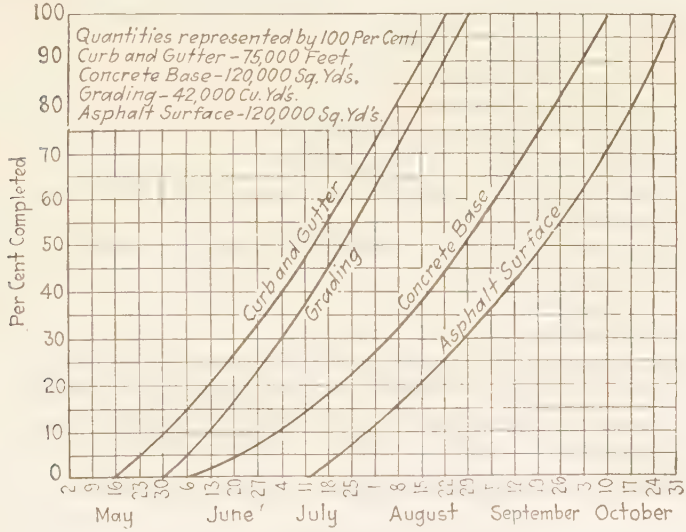

Fig. 18.—Estimated-progress diagram.

To illustrate the construction of the estimated-progress diagram, let it be assumed that a contract has been entered into for the construction of pavements on a system of streets, and that the major quantities involved are as follows:

120,000 square yards of 2-inch asphaltic concrete on a 6-inch concrete base.

75,000 lineal feet of concrete curb and gutter combined.

42,000 cubic yards of rough grading.

Date of beginning construction, May 1.

Date of completion, Nov. 1.

The constructor will decide upon the sequence of operations best suited for his organization, and then make up a diagram showing when each operation will begin and be completed. This is worked out with due regard to the necessity of completing certain operations well in advance of others. The resulting diagram is shown in Fig. 18.

The estimated-progress diagram may be made to serve as an operations diagram by using stations for ordinates instead of percentages. This is well illustrated in Fig. 19, which is typical of the progress diagrams used by the Massachusetts Highway Department.[1]

Actual-progress Diagrams.—The estimated-progress diagram is prepared before construction begins and represents the constructor's expected progress, it being the schedule to which he must adhere if he expects to complete the project within the time allowed by his contract. Upon this diagram or another of similar form, the actual progress of the construction will be indicated at stated intervals. The estimated-progress diagrams usually indicate the contemplated progress by regular lines, suggesting steady progress day by day. Unfortunately, construction never proceeds in that way and the actual progress will be indicated by an irregular line that illustrates only too clearly the vicissitudes of the highway constructor. So long as the actual progress averages near that proposed, there is no cause for concern; but if the average actual progress fall behind the proposed, some action should be taken to speed operations, or the intention to complete the work on time be abandoned.

Inspection organizations find the actual-progress diagram invaluable in checking the work of constructors, and the device is widely used. Busy executives can, in a few minutes, check the status of a large number of contracts by examination of the progress reports.

The block-line type of progress diagram is particularly useful as a means of presenting graphically general statistics, such as the season's progress on a group of contracts or the progress over a period of years in improving a system of highways. An illustration of the use of this type of diagram is presented in Fig. 20.

Available Time for Construction.—Highway contracts are usually awarded with a stipulation for completion within a prescribed time limit. In general, the contracts are awarded for units of

[1] Page, Austin E., *Eng. News-Record*, July 19, 1923.

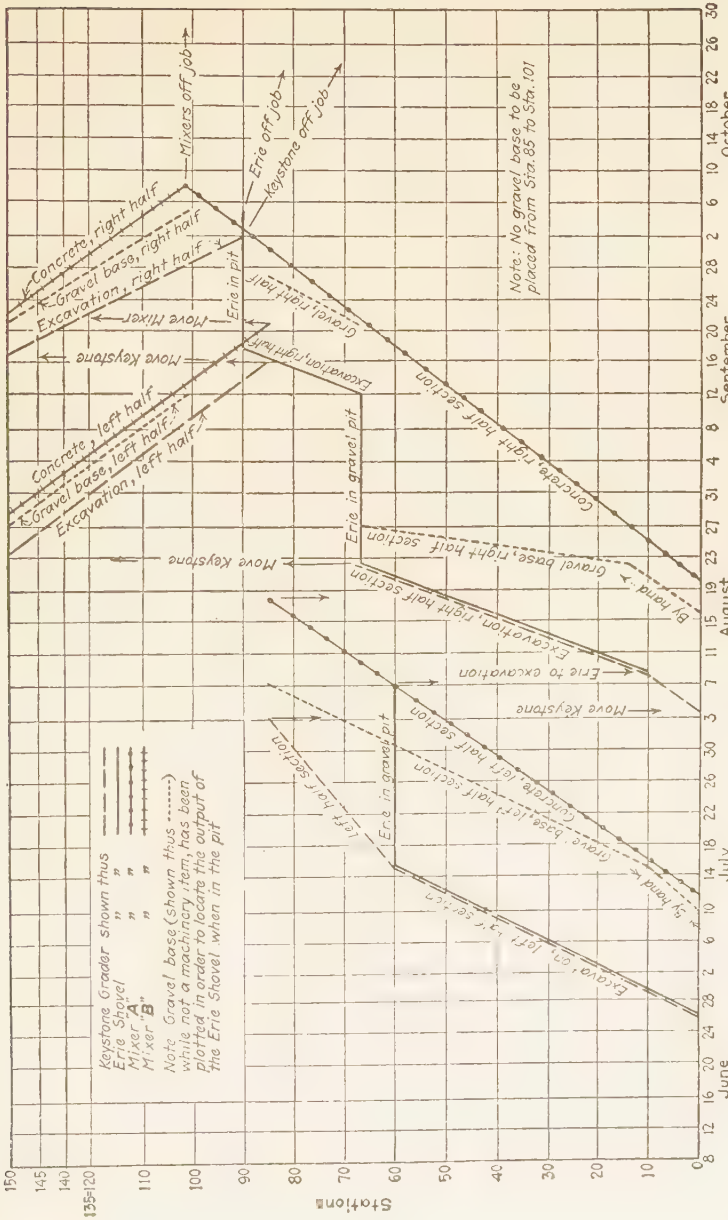

FIG. 19.—Progress and operations diagram.

such length that completion in one season is possible and the time limit is set accordingly. Highway construction, over a considerable part of the United States, is distinctly a seasonable occupation. In a few favored areas in the United States and in other countries, it may be possible to continue construction throughout the year. In either case there is almost invariably a time limit imposed. The period from the date of the contract to the date of completion is the contract period; but not all of this time is available for actual construction. Some time is required for organization and for moving in equipment, and during the progress of the work there will be time lost because of adverse weather

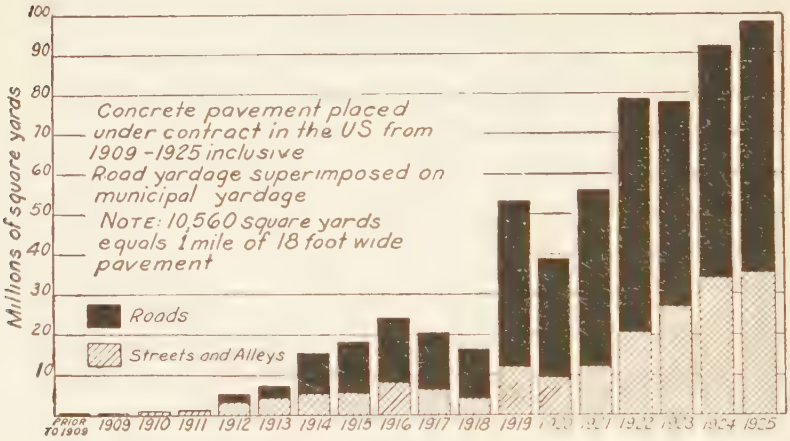

FIG. 20.—Block line diagram adapted to presentation of statistics.

conditions, breakdowns, lack of correlation of the various elements of the construction, and innumerable minor interruptions. Holidays and Sundays must be deducted. The actual number of working days will rarely exceed 75 per cent of the contract period, and the problem of management is to utilize the largest possible percentage of the contract period for actual construction operations.

The extent to which management affects the time lost during the contract period is well illustrated by Table XXIII, which is a summary of observations on nine concrete pavement contracts in Cook County, Illinois.[1]

One of the most painstaking studies of the causes of lost time during construction was made by H. K. Davis, Chief Inspector

[1] CONSOER, A. W., in *Eng. News-Record*, Apr. 14, 1921.

TABLE XXIII

Kind of work	Time lost, in per cent of contract period					
	Minimum	Maximum	Average	Chargeable to deficiencies in management		
				Minimum	Maximum	Average
Excavation	31	78	53	11	69	30
Hauling material	27	78	54	00	37	18
Paving	33	81	62	16	62	28

of the Iowa Highway Commission, from the results of which study the following summaries are presented.[1]

TABLE XXIV.—SHOWING TIME LOST IN ROAD CONSTRUCTION

General Data on Concrete Paving Operations in Iowa for 3 Years

	1921	1922	1923	Average
Total feet of pavement laid	798,245	532,401	519,399	616,682
Total miles of pavement laid	151.18	100.83	98.37	116.79
Average feet laid per construction outfit in season	27,525	28,021	34,627	30,058
Average miles laid per construction outfit in season	5.22	5.30	6.558	5.693
Total calendar days in construction season	223	217	215	218.3
Average calendar days elapsed on the work per outfit	114.3	100.8	117.5	110.87
Average days per outfit on which pavement was laid	74.1	61.2	76.4	70.57
Percentage of calendar days on which pavement was laid	64.80	60.73	65.04	63.52
Average feet laid per calendar day per outfit	241.0	278.0	294.8	271.3
Average feet laid per day worked by outfit	371.5	457.0	453.2	427.2
Construction outfits engaged	29	19	15	21

Whole Days Delays in 3 Years of Iowa Concrete Paving

Cause of delay	Per cent of total time spent on job			Average for 3 yrs.	Deviation from the average		
	1921	1922	1923		1921	1922	1923
Sundays and holidays	14.20	13.67	12.14	13.34	+0.86	+0.33	−1.20
Snow, rain, mud, and frost	14.70	9.72	15.27	13.23	+1.47	−3.51	+2.04
Breakdowns of equipment	1.09	0.47	0.74	0.77	+0.32	−0.30	−0.03
Shortages of materials	1.14	9.83	1.99	4.32	−3.18	+5.51	−2.33
Moving equipment	2.56	2.56	3.18	2.77	−0.21	−0.21	+0.41
All other causes	1.51	3.02	1.64	2.05	−0.54	+0.97	−0.41
Total, all causes	35.20	39.27	34.96	36.48	−1.28	+2.79	−1.52

[1] DAVIS, H. K., in *Eng. News-Record*, June 19, 1924.

TABLE XXIV.—SHOWING TIME LOST IN ROAD CONSTRUCTION.—(*Continued*)

Fractional-day Delays in 3 Years of Iowa Concrete Paving

Cause of delay	Per cent of days worked on which delays occurred			Average for 3 years	Deviation from the average		
	1921	1922	1923		1921	1922	1923
Snow, rain, mud, and frost	12.41	10.31	14.92	12.55	−0.14	−2.24	+2.37
Breakdowns of equipment	5.21	5.24	6.89	5.78	−0.57	−0.54	+1.11
Shortages of materials	2.51	3.35	4.10	3.32	−0.81	+0.03	+0.78
Moving equipment	1.58	3.78	3.67	3.01	−1.43	+0.77	+0.66
All other causes	4.55	6.70	12.39	7.88	−3.33	−1.18	+4.51
Total, all causes	26.26	29.38	41.97	32.54	−6.28	−3.16	+9.43

The following analysis of the causes of lost time on an asphaltic-concrete pavement with concrete base that was constructed between Absecon, New Jersey, and Atlantic City, New Jersey, was prepared by Albert A. Mahon.[1]

TABLE XXV

Time lost in laying concrete base, in per cent of total time on the job and prepared to work	Per cent
Time lost due to rain	7.9
Time lost on account of being too wet to pave	8.3
Time lost, shut down by inspector because of lack of finished grade	6.9
Actually worked	76.9
Total	100.00

Time lost in laying wearing surface, in per cent as above	Per cent
Time lost due to rain	14.1
Time lost account of holidays, breakdowns, and miscellaneous	3.4
Actually worked	82.5
Total	100.00

One more report on the causes of lost time in highway construction deserves to be mentioned herein. During the construction

[1] *Eng. News-Record*, Oct. 1, 1925.

of about 40 miles of concrete rural highway in Pennsylvania, Crosby Tappan kept records of the causes of delays, which he summarizes as follows:[1]

TABLE XXVI.—SHOWING DISTRIBUTION OF TOTAL TIME LOST

Cause of lost time	Per cent
Total time lost in per cent of available time	36.7
Weather	37
Holidays and Sundays	21
Breakdowns	5
Embargo	21
Moving plant	5
Strikes	3
Transportation failures	3
Trouble with inspectors	5

Job Organization.—The preliminaries to the organization have now been discussed and may be summarized as follows:

1. The project analysis which indicated the basic operations to be provided for.

2. The operations analysis which is a guide in selecting the type of mechanical equipment.

3. The construction of the estimated-progress diagram which is useful in determining the capacity required of the equipment and the size of the working force.

4. The estimate of probable actual working time available for performing the work, which is used in connection with (3) for determining the capacity of the equipment and the size of force required.

These are aids, and very valuable aids, to the constructor who is organizing a highway construction project, but after all are merely devices by which he checks his judgment as to the best types of equipment and the details of organization. It must be repeated that good management is all too rare in the highway construction field. Many engineers have had to stand idly by and see constructors throwing money away day after day because of inadequate organization and equipment, or through mismanagement of a well-equipped job. There can be no doubt that an intelligent use of the aids herein suggested will materially

[1] *Eng. News-Record*, Oct. 1, 1925.

reduce the losses chargeable to poor management, but no conceivable system will insure success without good superintendence. The qualifications of a good superintendent were admirably summarized by W. H. Rogers, President of Bates and Rogers Construction Company, in an interview reported by C. S. Hill.[1]

Qualifications.—It is clear that very pronounced qualifications are required of a good superintendent. Some of these are hard to define; others can be stated definitely. They are a good business head, practical engineering sense, quick decision, diplomacy, character, address, observation, loyalty, resonsibility, and persistence—in brief, the qualifications of a managing executive.

Construction is constantly calling for business judgment. To determine whether a certain action, or an alternative, will pay best requires keen business instinct. Planning not only how to construct, but how to construct in the quickest and cheapest way demands practical engineering ability. Both business and engineering problems often call for quick decision, and when emergencies arise, prompt action only may avert disaster. It is the business of the superintendent to get along with the men who work for him and for whom he works—it costs money to be at variance.

In the end, however, there must be more than technical and business qualifications. A truly successful superintendent must be a man of good habits, of good moral character, and have high ideals. He must realize that honesty is not only the best policy, but that it is right, and that it pays to have the reputation of doing honest work. The old idea that a contractor, in order to be successful, must be what is known as a good fellow, inclined to drink, and do other things that he should not, in order to entertain the engineers and others, is obsolete. Any amount of drinking with a man or entertaining him will not help in attaining success; but, on the other hand, may have just the opposite effect.

A good address is a valuable asset. While appearances are on the surface, sometimes the first impression made by the outward appearance is of vital importance. If practicable, the ability to express one's ideas clearly and forcibly in good language is invaluable.

The longer I live the more I am impressed with the importance of being able to talk convincingly on one's feet. The ability to go on a job and take it all in is also important. The habit of observation should be cultivated. Loyalty to the employer is, of course, essential. If one is not in sympathy with the people he works for, he should get out. The superintendent should be constantly striving to widen his acquaintance among engineers, contractors, and others with whom his company may later have business relations. He must always keep his eyes open

[1] *Eng. News-Record*, p. 758, Nov. 6, 1924.

to see how the other fellow does his work, ever ready to select better methods than those he is using. In doing this, he broadens his viewpoint and becomes a better engineer.

I have left to the last, two of the most important qualifications, without which I believe it is impossible to become successful. The first is the willingness to assume responsibility. It is far better to do something and do it wrong than to do nothing. The man who is always waiting for some one to tell him what to do and how to do it does not get anywhere. Take responsibility and put all that there is in you to do right what you have assumed to do. The other qualification is what I call "stick-to-it-iveness." The quitter should never enter the contracting game for there is no place for him in it. What is wanted is the man who does the thing he starts out to do, in spite of good reasons why it cannot be done; who does not know when he is beaten; who does not know how to quit. If there is a "yellow streak" or quitting streak in a man, he should never start in a career leading to that of a contractor's superintendent. We have in our organization men who, when they set out to do a task, do it. We simply forget that it is to be done and assume that it is as good as done when it is turned over to them. That is the kind of a man wanted as superintendent, and that kind of man is bound to succeed.

The principles involved in the organization of the personnel for highway construction in no wise differ from those involved in any other kind of construction. The basic idea may be stated thus: For each project, a superintendent; and for each basic operation, a foreman. Having worked out a project analysis for a contract, the number of foremen and their duties are at once apparent. It remains only to determine whether the work will be distributed over so much distance that one or more assistant superintendents will be required. If the work is to continue for more than one shift per day, an assistant superintendent will be required for each extra shift, and a complete organization of laborers and foremen will be used for each shift.

The following outline of the construction organization for a project involving about 20 miles of concrete rural highway is presented to illustrate the relation between project analysis and construction organization.[1]

The project analysis resulted in the establishment of the following basic operations:

1. Fine grading or "subgrading."

[1] Data obtained through the courtesy of C. F. Lytle, President of Lytle Construction Company, Sioux City, Iowa.

2. Central proportioning and mixing plant for concrete.
3. Placing and finishing concrete.
4. Curing concrete.
5. Commissary.
6. Mechanical service.
7. Water supply.
8. Accounting.

The actual organization employed on the job was as follows:
One superintendent and one assistant superintendent.

1. Preparation of subgrade.

Day Shift	Night Shift
1 foreman	1 foreman
25 laborers	6 laborers
1 roller operator	1 roller operator
1 turn-table operator	1 turn-table operator
2 form setters	

2. Central proportioning and mixing plant.

Day Shift	Night Shift
1 foreman	1 foreman
1 crane foreman	1 crane foreman
1 crane operator	1 crane operator
1 laborer to clean up cars and help shift cars	1 laborer to clean up cars and help shift cars
1 mixer operator	1 mixer operator
2 assistant mixer operators	2 assistant mixer operators
1 mixer-engine operator	2 mixer-engine operators
1 pump operator	1 pump operator
1 laborer, cleaning sacks	1 laborer, picking up sacks
1 laborer, picking up sacks	8 cement handlers
8 cement handlers	24 truck drivers
24 truck drivers	

3. Placing and finishing concrete road.

Day Shift	Night Shift
1 foreman	1 foreman
1 finishing-machine operator	1 finishing-machine operator
6 spreaders	6 spreaders
4 finishers	4 finishers
1 pump operator	1 pump operator
1 roller operator	1 roller operator
6 laborers on intakes	

4. Curing concrete.

Day Shift Only

1 foreman
12 laborers

5. Commissary.

Day Shift	Night Shift
1 cook	1 second cook
3 helpers	2 helpers

6. Mechanical service.

Day Shift	Night Shift
1 general mechanic	1 general mechanic
1 mechanic's helper	1 mechanic's helper
2 truck mechanics	1 truck mechanic
	1 truck mechanic's helper

7. Water supply for curing concrete.

Day Shift Only
1 pipe-line foreman
2 pipe-line helpers

8. Accounting and timekeeping.

Day Shift	Night Shift
1 timekeeper	1 timekeeper

Estimates for General Budget Purposes.—In the planning of construction programs, it frequently becomes necessary to prepare estimates of the cost of road surfaces and auxiliary structures for the purpose of financial administration. Such estimates rarely require a greater degree of accuracy than that resulting from applying general unit-cost figures based on previous work in the immediate vicinity. Each engineering and each contracting organization possesses records of costs that may be used for the purpose and as a general rule the tendency is to place the most optimistic interpretation on the attendant conditions unless it is known positively that for part of the work adverse conditions may be expected.

In the promotion of highway construction, particularly street improvements, it is all too common to find that preliminary estimates are entirely too low. This is due to an aversion to submitting figures that may tend to discourage officials in proceeding with a project. On the other hand, when the true cost of the work is known, as when bids are received, and this cost proves to be far in excess of the preliminary estimates, the reaction on public officials is bad. It tends to raise a doubt in their minds as to the ability of the engineer who prepares preliminary estimates and may cause all sorts of financial difficulties. For these reasons, the preliminary estimates for general budget purposes and those submitted in the promotion of highway improvements should be prepared with some care and should be as nearly what the estimator thinks the job will actually cost as is possible in the

premises. It is best for public officials to face the true situation at the beginning of the project rather than after a considerable amount of preliminary work has been completed.

Estimates for Bidding Purposes.—The first step in preparing an estimate for bidding purposes is to abstract the quantities from the plans for the work, and this abstract should be carefully checked against the engineer's estimate of quantities, if one is furnished. The items in the list of estimated quantities then will be subdivided into the units of material that enter into each class of construction and the basic labor items involved. An estimate sheet that is used by a state highway department is shown in Fig. 21, and illustrates the usual method of procedure. Other subdivisions of the labor items might be made if desired, or if the cost records to be used are combined in a different manner from those shown on the sheet.

The second step in preparing estimates is to read carefully and painstakingly the specifications covering the work. It is unwise to assume that the specifications are like any others with which the estimator is familiar, except in the case of printed standard specifications bearing a date, and even these may have been revised, or may contain interlineations that greatly modify the original provisions. If any provision is not clear, or is of doubtful application, a written interpretation should be secured.

The third step is to make a careful inspection of the site of the proposed work to ascertain the conditions under which the work will be performed. At this time a tentative plan of operations will be prepared, and the effect upon the cost of construction of all local conditions will be calculated. The local labor and housing situation will be ascertained. The physical condition of the site will be studied, and the rail transportation facilities will be determined if any materials or supplies are to be shipped in. It will be determined whether local licenses must be secured in connection with any part of the work and the cost thereof. Such an inspection should be made by the constructor or one of his principal assistants, together with the superintendent, if possible.

The fourth step is to prepare a project analysis for the job, and to determine the mechanical equipment to be used. In this connection a constructor must often plan to use equipment not best suited to the job, because he already owns it and the work is not sufficient in extent to justify the purchase of major equipment.

At this time, there also will be prepared an estimated-progress diagram or a tabulation intended to serve the same purpose.

FORM 111

ILLINOIS STATE HIGHWAY DEPARTMENT

Itemized Estimate of Cost of

BRICK ROAD

County .....
Section .....
Route .....

Improvement to begin Sta ..... to end Sta. .....

Length to be improved ..... ft. width ..... ft. with ..... macadam shoulders.

Areas: Pavement, including curbs ..... sq. yds. Brick surface ..... sq. yds. Macadam ..... sq. yds.

Money available, $ ..... Earth shoulders ..... sq. yds. Concrete gutters ..... sq. yds.

MATERIALS.	Total Cost.	Per sq. yd.
Cement for base, curbs, and grout ..... bbls @ ..... per bbl.		
Fine aggregate for base, curbs, and grout ..... cu. yds. @ ..... per cu. yd.		
Coarse aggregate for base and curbs ..... cu. yds. @ ..... per cu. yd.		
Brick for pavement ..... M. @ ..... per M.		
Sand for cushion ..... cu. yds. @ ..... per. cu. yd.		
Material for joints ..... lineal ft. @ ..... per ft.		
Water		
Forms		
Aggregate for longitudinal and lateral drains ..... cu. yds. @ ..... per cu. yd.		
.....		
.....		
Cost of Materials		
LABOR.		
Cost per hr. Workmen ..... cts. Teams ..... cts.		
Shaping and rolling subgrade		
Hauling cement ..... bbls. ..... miles @ ..... cts. per bbl.		
Loading fine aggregate and sand ..... cu. yds. @ ..... cts. per cu. yd.		
Hauling fine aggregate and sand ..... cu. yds. ..... miles @ ..... cts. per cu. yd.		
Loading coarse aggregate ..... cu. yds. @ ..... cts. per cu. yd		
Hauling coarse aggregate ..... cu. yds. ..... miles @ ..... cts. per cu. yd.		
Loading and unloading brick ..... M. @ ..... cts. per M.		
Hauling brick ..... M. ..... mi. @ ..... cts. per M.		
Incidental hauling		
Mixing and placing concrete and building forms for base and curb		
Placing and preparing sand cushion		
Laying and rolling brick and placing expansion joints		
Grouting joints in brick		
Covering, seasoning and cleaning pavement		
Longitudinal and lateral drains. Excavation, hauling and placing		
Shaping and rolling earth shoulders, gutters and side roads		
Superintendence		
Cost of materials and labor		
EXTRA MATERIALS AND LABOR.		
Excavation ..... cu. yds. @ ..... per cu yd.		
Borrow ..... cu. yds. @ ..... per cu. yd.		
Macadam shoulders complete ..... sq. yds. @ ..... per sq. yd		
Rip-rap complete in place ..... sq. yds. @ ..... per sq. yd.		
Tile drain complete ..... lineal ft. ..... in. drain @ ..... per ft.		
Concrete gutters complete ..... sq. yds. @ ..... per sq. yd.		
Bridges, culverts, baffle walls, head walls, etc:-		
Plain concrete ..... cu. yds. @ ..... per cu. yd.		
Reinforced concrete ..... cu. yds. @ ..... per cu. yd.		
Temporary roads and bridges, damages, etc.		
Land for relocation, corners, borrow pits etc. ..... acres @ ..... per acre.		
Total cost exclusive of profit and overhead		
Cement required:-		
..... bbls. in base, curbs, and joints		
bbls. in grouted gutters		
bbls. in plain concrete for bridges, culverts, walls, etc.		
bbls. in reinforced concrete for bridges, culverts, walls, etc.		
Total ..... bbls. cement @ ..... per bbl.		
Total cost exclusive of cement, profit and overhead		
Overhead, contingencies and profit ..... per cent.		
Total cost of road, exclusive of cement		
Absolute total cost of road		

Computed by .....
Checked by .....
Date .....

Approved ..... Road Engineer.

FIG. 21.—Typical estimate sheet.

It is at this stage of the procedure that many estimators fail. They overlook elements of cost that would be apparent if they actually laid out the job completely. Too often, they depend upon securing profitable execution by sheer driving force that

exacts from every animal and every man the last ounce of energy. Other constructors, while recognizing the necessity for energetic prosecution of construction, utilize mechanical equipment and cost-saving methods to the fullest possible extent. The competition for contracts is so keen that the constructor who can conceive new schemes for reducing costs will have at least a small margin of advantage in bidding.

The fifth step in estimating is to decide what cost figure to use for each item on the itemized estimate sheet. Cost of materials and supplies are obtained from price sheets submitted by supply concerns or from listed cost sheets for materials and supplies to be taken from the constructor's own warehouse. Labor and equipment costs are determined from the records of previous work, modified in accordance with the estimator's judgment as to the exact conditions on the proposed work. Needless to say, this part of the estimate requires very careful checking and at least two persons should go over the items. The completed price sheet then should be reviewed by the officials of the company in conference with the superintendent who will be assigned to the contract. When it is certain that the prices are as nearly correct as they can be estimated, the totals are determined by computation. Such computations should be made entirely independently by two experienced persons and the results made to check.

Items of central office costs, bond, financing, insurance, and supervision are allocated to the estimated total according to the system adopted by the constructor. The expected percentage of profit is then added and the bid price is then fully determined.

Engineer's Estimate of Cost. — In many kinds of highway construction, an estimate of cost is prepared by the engineer to serve as a guide to the board that is to award the contract. Since this estimate will be the basis for determining whether the proposals are reasonable, it should be made up with the same painstaking thoroughness as the estimate for bidding purposes, and the methods are identical. It often happens, however, that the engineering organization does not have available as complete or diversified records of cost as does the constructor's organization, but must rely more upon the judgment and experience of the estimator. These estimates are often the means of detecting errors in the estimates prepared for bidding purposes and thereby save the constructor from possible loss.

It has been a fruitful subject of discussion as to whether the engineer's estimate of cost should be available to those who are preparing proposals for the construction, and there are long arguments that might be advanced on each side of the question. To repeat them here would serve no useful purpose, and it will be enough to say that in some places it is customary to publish the estimates in advance of the filing of bids, and in others the engineer's estimate is filed with the board that is awarding the contract and is used by them as confidential information. There seems to be no decided trend in either direction with reference to this practice.

Efficiency Studies.—In a previous section there was presented some data on time lost in highway construction due to unfavorable weather conditions, holidays, lack of materials, and similar major hindrances. These may be anticipated and taken into account in estimating and over a period of years will probably vary but little from a general average. Certain of the delays, such as those due to lack of materials, can be minimized, if not entirely eliminated, by good management.

Another class of delays, with an attendant loss in production, is made up of constantly recurring small delays that are due either to lack of correlation of the elementary operations on a job, to incorrect manipulation of some piece of equipment, or to the time-wasting manner in which some operations are performed. A part of the technique of job management consists in ferreting out these small losses and correcting the job procedure so as to eliminate them. Usually, the losses are small, sometimes as small as $\frac{1}{10}$ minute,[1] but when an operation is repeated forty or fifty times in an hour, the aggregate loss becomes exceedingly significant. These losses are detected by efficiency studies of each operation, often with the aid of a stop watch, and a painstaking evolution of a method that will eliminate each delay that is detected.

Coordination of Construction Operations.—When the progress of one of the basic operations in the construction of a highway falls below the rate necessary to avoid interference with other operations, loss of time and money result. The rakers on an asphalt job may be compelled to wait for the delivery of the hot mixture; a concrete mixer may wait for the delivery of aggregates; trucks may wait unduly for the cement to be loaded, or the plac-

[1] HARRISON, J. L., in *Public Roads*, April, May, and June, 1925.

ing of concrete may be delayed by the failure of the gang on fine grading to progress with sufficient rapidity. Conversely, the trucks delivering the hot asphalt mixture may be delayed in unloading by the slowness of the rakers; or trucks loaded with aggregates may be delayed at the mixer. All delays of this class are evidences of lack of coordination.

It is probably impossible to organize all elements of a highway construction job so as wholly to eliminate loss of time by some of the elements, yet good management will eliminate most of this type of loss. In planning the progress of the several elements of the job, it is well to select, first, the operation that sets the pace for the whole job, and to build the organization around that operation.

In all forms of road-surface construction involving the placing of concrete, the concrete-mixing and concrete-placing equipment sets the pace. The whole system of construction should be evolved on the hypothesis that the mixing and placing of concrete must progress at the maximum rate possible with the mixer in use. This rate being determined, it is a fairly simple matter to adjust the rate of subgrade preparation and form setting so that the mixer will not be compelled to wait for finished subgrade. It is also possible to adjust the forces at a proportioning plant so that trucks are loaded promptly. It is not so easy to adjust the number of trucks so that there will be no waiting at either end of the haul, but careful daily checking will eliminate surplus transportation. No system of organization can prevent delays due to the failure of equipment, but reports on lost time during construction indicate that these delays constitute a negligible factor, when equipment is regularly inspected and serviced.

In laying asphalt pavements, the key operation is the mixing plant. The transportation and the size of the street gang are adjusted to insure that the mixing plant can operate continuously at capacity. The number of rakers and shovelers can be adjusted to prevent delays of the transportation. At the plant the number of laborers can be adjusted to insure the maximum output of which the plant is capable.

In performing rough grading where the elevating grader is used as a loader, the transportation is adjusted to keep the elevator at maximum capacity.

In all of these operations, delays of any duration are serious, but those of any considerable length will not escape notice and

will be corrected by the management. When operations are repeated many times in an hour, with a crew of a dozen or more men and an expensive piece of machinery involved, small delays, even those of a few seconds repeated in each cycle of the operation, reduce output to an astonishing degree, and yet are likely to be overlooked except by the keenest of superintendents.

Correlation consists in adjusting the several operations so that a routine is established by which each piece of equipment operates to full capacity throughout the working period, with reserves of minor equipment still further to reduce the probability of lost time by the major equipment.

Time Studies.—The various elements of a construction project may be correlated so that the major equipment is operating at maximum output, but the elementary operations involved may not be performed with the minimum labor. In simple types of construction there may be loss of time because of defective organization. An illuminating example of this was uncovered in an investigation of rough grading with fresnos where it was determined that, by a slight readjustment of the route of the teams and greater attention to full loading, a losing contract could be converted into a profitable one. Even more serious losses in efficiency were uncovered in analysis of more intricate types of construction.[1]

Similarly, a contractor, who was laying the concrete base for a brick pavement, found that he could gain a few seconds on each batch of concrete by a modification of the method the mixer operator used in discharging and reloading the mixing drum.

In another contract there was a loss of a few seconds in loading each car of an industrial railway train on account of the inaccessible location of the levers controlling the gates to the materials bins.

These various deficiencies were brought out by a careful study of each elementary operation by the superintendent. Time studies of this class are often made with a stop watch and in some cases require infinite pains before the leak is detected. They often result in the rearrangement of apparatus, the rerouting of transportation, or the entire revamping of certain elementary operations. They should extend to every part of the work and should take into account the necessity of preventing undue fatigue on the part of any one laborer.

[1] HARRISON, J. L., in *Public Roads*, November and December, 1925.

The factory method of performing time studies is applied in principle to the analysis of the efficiency of construction, but the very nature of the work precludes the establishment of a factory precision in the timing of operations. What is attempted is elimination of time-wasting movements on the part of laborers or of equipment in so far as it can be accomplished in road construction.

COST KEEPING AND ACCOUNTING

The term "cost keeping" is used herein to designate a system of records whereby the true total cost of any unit of structure or of the complete structure may be calculated. These costs are usually expressed in terms of money, but cost records also should permit the calculation of cost in terms of man-hours and machine-hours.

The term "accounting" is used to designate the process by which the profit or loss status of a job may be determined at any period of the construction.

Many of the data employed are common to both cost keeping and accounting.

COST KEEPING

Three kinds of cost items are involved in highway construction. They are:

1. Labor costs.
2. Materials costs.
3. Cost of supervision and general overhead.

The division is made in this way so that the records obtained will be applicable to other jobs of similar character if interpreted properly. Material and labor costs are desired for certain customary units of product, such as the cubic yard of concrete or the square yard of pavement surface. If the costs records are taken correctly, they can be applied to any desired unit of product.[1]

Two elements enter into the cost record, expenditure and accomplishment. A system of cost keeping, therefore, must show expenditures and accomplishment for corresponding periods of time if the data are to be used in connection with an accounting system. This is generally the plan employed by constructors.

[1] For a very comprehensive discussion of this subject see "Highway Cost Keeping," by Tobin, James J., and Losh, A. R., U. S. Dept. of Agriculture *Bull.* 660.

If it is desired to know the cost of completed work only, then it is unnecessary to do more than secure a record of the total cost and the total accomplishment; but the total cost ordinarily may be secured most readily by recording the daily or weekly cost. The cost records obtained by most of the highway departments are secured in this way. That is, the total cost and the total accomplishment are recorded.

The basis of the labor-cost record is time keeping. Seemingly, this is a simple operation. One merely secures a stock time book at any stationery store and enters therein the name or number of each workman and foreman with the rate of pay and the hours worked each day. While this is the first and the easiest part of time keeping, it is by no means a light occupation if the job is a typical highway or street-paving contract. Men are working at a number of different locations, are continually shifting about, and frequently work only part of a day. The gang at one operation may work 4 hours, another gang 6, and perhaps a few men will work 1 or 2 hours, and for overtime they will receive an increase in the standard rate of pay. So, the accurate recording of the hours of labor requires some care and alertness. In building construction and other construction operations that are concentrated in a small area, the time clock and check system can be used to advantage and is, in fact, generally employed. In highway construction it is more common to require the timekeeper to secure the names of laborers from the various foremen. This list is checked by a count of the men who are at work.

The other part of time keeping is the distribution of labor to the various operations involved in the particular job. In order to be able to compute man-hours of labor on any element of the construction, it is necessary to keep an accurate record of the kind of work performed by each individual employed. This distribution may be made weekly in the simpler kinds of road work, since the elementary operations are few in number and the laborers are seldom changed from one task to another. Records for the more complicated types of road work rarely will be dependable unless a daily distribution of labor cost is made.

Accounting for materials that enter into highway construction involves securing two kinds of information. The first is a record of materials received on the job and will include the source, the quantity, the freight, if a rail shipment, and the disposition of the material on the job. The accumulated totals shown by these

TABLE XXVII.—MINNESOTA HIGHWAY DEPARTMENT—ITEMIZED SCHEDULE OF CONSTRUCTION WORK, 1925

Year	Month		Democrat	County		Trunk highway	Projects	Section	A.F.E.	Serial or employment number	Branch	Class
1921-1	Jan	1	1 Peries	Aitkin	01			1	Authority for expenditures	Labor series	General 1	Administrative 1
1922-2	Feb	2	2 Baker	Anoka	02			2				
1923-3	Mar	3	3 Hygare	Becker	03			3		Engineers, Assts. and Clerks	Engineering 2	Grading 2
1924-4	Apr	4	4 Scales	Beltrami	04			4				
1925-5	May	5	5 Meehan	Benton	05			5	A.F.E. 01	01,001–10,000	Contract 3	Structures 3
1926-6	June	6	6. Chapman	Big Stone	06			6	General charges other than salaries and wages items No. 611 to 614	Skilled and common 10,001–40,000	Cost—plus 4	Grav. surfacing 4
1927-7	July	7	7 Matters	Blue Earth	07			7			Day—labor 5	Hard surfacing 5
1928-8	Aug	8	8. Marl	Brown	08			8				
1929-9	Sept	9		Carlton	09			9				
1930-0	Oct	10		Carver	10				A.F.E. 02–20 All expenditures for preliminary and location surveys Item No. 051	Materials and supplies series	Maintenance 6	Misc. structures 6
	Nov	11		Cass	11							Right of way 7
	Dec	12		Chippewa	12					Dealers– 40,001–50,000		Equipment and misc. supplies 8
				Chisago	13							Bonds 9
				Clay	14							
				Clearwater	15							Proration 0
				Cook	16				A.F.E. 21 All expenditures for engineering-supervision of field construction items No. 053 and 054	Transfer of funds memorandum 50,001–55,000		
				Cottonwood	17							
				Crow Wing	18							
				Dakota	19							
				Dodge	20							
				Douglas	21							
				Faribault	22							
				Fillmore	23							
				Freeborn	24				A.F.E. 22 All expenditures for R.O.W., items No. 004,601 to 604,051 (R/W Surveys)	Contractors series 55,001–65,000		
				Goodhue	25							
				Grant	26							
				Hennepin	27							
				Houston	28							
				Hubbard	29							
				Isanti	30					Right of way series		
				Itasca	31				A.F.E. 24 Administration salaries and expenses, items No. 001, 006 and 007, 058	Purchases 65,001–70,000		
				Jackson	32							
				Kanabec	33							
				Kandiyohi	34							
				Kittson	35							
				Koochiching	36					Leases 75,001–		
				Lac Qui Parle	37				A.F.E. 25 Road plans, salaries and expenses, items No.			
				Lake	38							
				Lake of the Woods	39							
				Le Sueur	40							

Lincoln	41			003,059,060
Lyon	42			063,064,065,070,
McLeod	43			072
Mahnomen	44			A.F.E. 26
Marshall	45			Bridge plans, sala-
Martin	46			ries and expenses,
Meeker	47			items No. 002,
Mille Lacs	48			061,062,068
Morrison	49			A.F.E. 27
Mower	50			Lab. salaries and
Murray	51			expenses (Mpls
Nicollet	52			and Duluth Lab-
Nobles	53			ratories) items
Norman	54			No.
Olmsted	55			005,052,055,056
Otter tail	56			057,067,069,071
Pennington	57			A.F.E. 90
Pine	58			Judicial ditch
Pipestone	59			assessments
Polk	60			item No. 701
Pope	61			A.F.E. 91
Ramsey	62			Work for mainte-
Red Lake	63			nance Dept.
Redwood	64			A.F.E. 92
Renville	65			Employees com-
Rice	66			pensation, item
Rock	67			No. 702
Roseau	68			A.F.E. 93
St. Louis	69			Saint Parks item
Scott	70			No. 066
Sherburne	71			A.F.E. 95
Sibley	72			Interest and prin-
Stearns	73			cipal on bonds,
Steele	74			items No. 621 to
Stevens	75			626
Swift	76			A.F.E. 97
Todd	77			Retained per cent
Traverse	78			on contracts,
Wabasha	79			item X
Wadena	80			A.F.E. 00
Waseca	81			Location prora-
Washington	82			tion, item No.
Watonwan	83			051
Wilkin	84			
Winona	85			
Wright	86			
Yellow Medicine	87			

Trunk highways 01–70

State projects—021–099

State refund projects—001–020

TABLE XXVII.—MINNESOTA HIGHWAY DAPARTMENT ITEMIZED SCHEDULE OF CONSTRUCTION WORK, 1925.—*(Continued)*

Item		Accomplishment unit	
Administrative			
General overhead expenses' salaries and expenses—also division, bridge and office engineers)		Miles—Surveys	01
Bridge (including salary and expense of asst. bridge engineer)		Number surveys—Bridge	02
Plans (including salary and expense of engineer of plans and assistants)		Miles—Alternate surveys	03
Right of way (including salary and expenses)		Miles—plans	06
Tests and inspection (including salary and expense of engineer of tests)		Miles—plans revision	07
Construction—clerical and accounting (including salary and expense)		Number trees	11
Library (salary and expense)		Acres trees	12
Engineering		Acres brush	13
Preliminary and location survey		Cubic yards earth	14
Material surveys		Cubic yards loose rock	15
Field supervision		Cubic yards solid rock	16
Field inspection and tests		Cubic yards overhaul	17
Laboratory inspection tests		Linear feet specified plowing	18
Commercial tests and inspection		Linear feet fencing	19
Experimentation		Number poles	20
Special engineering—consulting		Cubic yards backfilling	25
Drafting road plans		Cubic yards, placing conc.	26
Drafting state-aid plans		Pounds reinforcing steel	27
Drafting bridge plans		Pounds structural steel	28
Drafting state-aid bridge plans		Linear feet piling	29
Drafting misc. construction		Number old bridges removed	30
Drafting misc. maintenance		Number temporary bridges constructed	31
Drafting misc. administration		Linear feet railing	32
Surveys and plans of state parks		Square yards surfacing	33
Test and inspection state-aid structures		Installing pipe 4 inches lin.-feet	36
Drafting bridge and culv. standards		Installing pipe, 6 inches lin.-feet	37
Core drilling		Installing pipe, 8 inches lin.-feet	38
Checking finals		Installing pipe, 10 inches lin.-feet	39
Investigations and research		Installing pipe, 12 inches lin.-feet	40
Drafting new county maps		Installing pipe, 14 inches lin.-feet	41
Grading		Installing pipe, 15 inches lin.-feet	42
Clearing		Installing pipe, 18 inches lin.-feet	43
Grubbing		Installing pipe, 24 inches lin.-feet	44
Excavation		Installing pipe, 30 inches lin.-feet	45
Hand ditching		Installing pipe, 36 inches lin.-feet	46
Gravel Surfacing		Installing pipe, 42 inches lin.-feet	47
Material		Installing pipe, 48 inches lin.-feet	48
Stripping pits		Ton-mile haul	52
Screening gravel	001	Cubic yards, porous backfill	53
Load and haul		Cubic yards	56
Shaping and compacting	002	0—½ mile	57
Raising roadbed		½—1 mile	58
Gravel checking	003		
Prospecting, test pitting			
Stock piles	004		
Clay Surfacing			
Material	005		
Stripping			
	006		
Load and haul	007		
Shaping and compacting			
Plow in clay on subgrade	051		
Clay checking	052		
Prospecting, test pitting	053		
Hard Surfacing			
Fine grading	054		
Bit. macadam penetration	055		
Water bound macadam	056		
Asphaltic concrete—Class A	057		
Asphaltic concrete—Class B	058		
Asphaltic concrete—Class C	059		
Asphaltic concrete—Class Warrente	060		
	061		
	062		
One course concrete—crushed stone—mesh reinforcing	063		
	064		
One course concrete—crushed stone—bar reinforcing	065		
	066		
One course concrete—gravel—mesh reinforcing	067		
	068		
One course concrete—gravel—bar reinforcing	069		
	070		
Plain cement concrete base	071		
Broken stone base	072		
Brick pavement—bit. filled			
Wood block pavement	101		
Integral curb	102		
Shoulders	103		
Seeding shoulders	104		
Right-of-way			
Right-of-way	301		
Sand pits	302		
Gravel pits	303		
Quarries	304		
Clay pits	305		
Miscellaneous Expenditures			
Misc. Field expenditures	306		
Misc. Office expenditures	307		
Misc. Mpls. Lab. expenditures	308		
Misc. Duluth Lab. expenditures	309		
	311		
	312		
Bonds	313		
Bonds—Chap. 66	314		
Bonds—Chap. 265 and 349	315		
Bonds—Chap. 522	316		
Bonds—Chap. 329	317		
Bonds—Chap. 184	318		
Bonds—Chap. 316			
Specials	101		
Judicial ditch	402		
Industrial compensation and expenditures	403		
	404		
	405		
	406		
	407		
	408		
	409		
	410		
	411		
	412		
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	414		
	415		
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	614		
	621		
	622		
	623		
	624		
	625		
	701		
	702		

Special excavation	105
Special plowing	106
Moving tel. telg. power poles and conduits	107
Moving bldgs., fences and wells, etc.	108
Const. of detours and maintenance on old roads	109
Filling washouts	110
Seeding shoulders	111
Structures	
Bridges	201
Monolithic culverts	202
Portable culverts C.M	203
Portable culverts P.I	205
Tiling (clay tile)	205
Tiling (conc. tile)	206
Portable culverts P. 3	207
Sewer pipe	208

Misc. Structures	
Guard rail—wood	501
Guard rail—concrete	502
Guard rail—cable	503
Guard rail—masonry	504
Gutter—plain rubble	505
Gutter—grouted	506
Gutter—concrete	507
Gutter—metal	508
Catch basins	509
Spillways—concrete	510
Outlets	511
Curbing—concrete	512
Curbing—stone	513
Retaining walls—masonry	515
Retaining walls—concrete	516
Rip-rap	518
Reset section monuments	519
Concrete endwalls	520
Stone drains	521
Tile outlet headwalls	522
Tile outlet markers	523
Cribbing	524

To 1 mile point	59
Cubic yards, miles	60
Square yards	63
Shoulders—earth, cubic yards	64
Shoulders—gravel, cubic yards	65
Shoulders—cr. stone, cubic yards	66
Shoulders—cinders, cubic yards	67
Number of catch basins, spillways, etc.	71
Linear-feet guard rails, gutters, etc.	72
Acres—right-of-way	76
Number (pits, quarries)	77
Miles of	80
Number of	81

TABLES XXVII.—MINNESOTA HIGHWAY DEPARTMENT—ITEMIZED SCHEDULE OF CONSTRUCTION WORK, 1925.—(*Continued*)

Commodity				Quantity or time	Amount
Labor					
General supervision (department heads and assistants)		days	001		
Office employees (engineers, designers, computers, draftsmen)		hours	002		
Office employees (accountants and clerks)		days	003		
Field engineers and assistants,		days	004		
Field checkers, time keepers, field clerks,		days	005		
Superintendent to straw boss		days	006		
Skilled labor (mech's, carpenters)		hours	007		
Unskilled labor		hours	008		
Man and car or motorcycle		hours	009		
Man and truck		hours	010		
Man and tractor		hours	011		
Man and team		hours	012		
Extra team and horse		hours	013		
Employees disability-comp			014		
Purchase of Materials					
Dirt		cu. yds.	101		
Gravel		cu. yds.	102		
Sand		cu. yds.	103		
Clay		cu. yds.	104		
Stone		cu. yds.	105		
Crushed rock		cu. yds.	106		
Cement		Bbls.	107		
Lumber		F.B.M.	108		
Paint		Gals.	109		
Asphalt		Bbls.	110		
Road oil		Bbls.	111		
Tar		Bbls.	112		
Reinforcing steel		Lbs.	113		
Reinforcing wire mesh		Lbs.	114		
Structural steel		Lbs.	115		
Post-guard rail		No.	116		
Cable		lin. ft.	117		
Pipe	4″	lin. ft.	118		
Pipe	6″	lin. ft.	119		
Pipe	8″	lin. ft.	120		
Pipe	10″	lin. ft.	121		
Pipe	12″	lin. ft.	122		
Purchase of Major Construction Equipment					
Automobiles			301		
Trucks			302		
Motorcycles			303		
Tractors			304		
Elevating graders			305		
Drags			306		
Blades			307		
Scrapers			308		
Gravel spreaders			309		
Fresnos			310		
Plows			311		
Concrete mixers			312		
Dump wagons			313		
Steam shovels			314		
Misc. (wheel-barrows, etc.)			315		
Motor Equipment Maintenance and Operation					
Gas, oil and alcohol, gallons			401		
Repairs			402		
Betterments			403		
Replacements—parts			404		
Depreciation			405		
Miscellaneous supplies (waste, etc.)			406		
Storage (garage)			407		
Construction Equipment Maintenance and Operation					
Repairs			501		
Betterments			502		
Replacements—parts			503		
Depreciation			504		
Supplies (coal, wood, etc.)			505		
Rentals					
Transits		month	551		
Levels		month	552		
			553		
Automobiles		miles	554		
Automobiles		day	555		
Tractors		day	556		
Trucks		day	557		
Miscellaneous Field Expenditures					
Board and lodging			601		
Camp operat.—constr. (mat. and labor)			602		
Camp operat.—equip. (dishes, beds, etc.)			603		
Camp operat.—provisions, supplies, cooks salary and expenses, drayage and maintenance			604		
Camp operat.—rental (bldgs. grounds, tents, equipment, etc.)			605		
Misc. supplies (stakes, nails, paint, stationery etc.) postage, heat, light			606		
Freight, express, drayage, tel. and telg.			607		
Travel expense (R. R. fare, bus, sleeper, boat, livery, ferry, towage, board and lodging en route)			608		
Med. hosp. and misc. injury expense			609		
Miscellaneous Central Office and Laboratory Expenditures					
Tabulator, operation—supplies			626		
Tabulator, operation—labor, rental and maintenance			627		
Miscellaneous supplies, heat and light			628		
Freight, express, drayage, tel. and telg.			629		
Stationery, printing, postage			630		
Books and magazines			631		
Right-of-way					
Options			651		
Legal expense			652		
Damages			653		
Purchase			654		
Lease			655		
Special agreements			656		
Misc. right-of-way expenditures			657		
Bonds					
Interest			676		
Principal			677		

Pipe	14″	lin. ft.	123
Pipe	15′	lin. ft.	124
Pipe	18″	lin. ft.	125
Pipe	24″	lin. ft.	126
Pipe	30″	lin. ft.	127
Pipe	36′	lin. ft.	128
Pipe	42″	lin. ft.	129
Pipe	48″	lin. ft.	130
Wire		Spool	131
Piling		lin. ft.	132
Pipe (iron)		lin. ft.	133
Seed			134
Man-hole covers			135
Explosives			136
Brick		No.	137

Purchase of Office and Field Engineering Equipment

Transits	201
Levels	202
Hand levels	203
Rods and pickets	204
Chains and tapes	205
Typewriters	206
Calculators	207
Planimeters	208
Miscellaneous (axes, sledges, saws, shovels, etc.)	209
Repairs and betterments	210
Miscellaneous drafting equipment	211
Miscellaneous laboratory equipment	212

Bladers	day	558
Elevating grader	day	559
Steam shovels	day	560
Drags	day	561
Slips, fresnos, wheelers, etc.	day	562
Dump wagons	day	563
Conc. mixers	day	564
Locomotives	day	565
Dump cars	day	566
Road rollers	day	567
Pile drivers	day	568
Office space	month	569
Storage space	month	570
Misc. equipment (axes, saws, etc.)		571
Misc. field office eng. equip. (typewriters, etc.)		572

Contract bond	678
Personal bond	679
Liability insurance	680

Contracts

Contract and special agreement	800
Contract retained percentage	801
Contract penalties	802
Contract other deductions	803

Specials

Assessments	901

records must check with the total obtained from the daily or weekly record of materials used. The daily or weekly report of materials received is the basis for the payment of freight bills and invoices, and if the materials were forwarded from the contractor's warehouse, they are charged to the job and credited to stores. This is determined from the number of units of completed work that were produced during the period, checked by invoice of materials on hand and by frequent determinations of the actual quantity of each material required per unit of product.

The basic purposes underlying highway cost keeping need to be emphasized at this point. They are: to enable the management of an organization to determine the profit or loss status of a project; and to permit calculation of the cost per unit of product for any element of the construction at any stage of progress of the work and at completion.

The units of product for which costs will be desired by a constructor are those that were used in preparing estimates for the construction, which may not be the same as the units upon which proposals were submitted. The highway department may be interested only in the costs of the units upon which bids were submitted, or in the total cost of the completed project.

It follows, therefore, that the distribution of construction cost must be made in accordance with the system of estimating the constructor has employed. Instead of allowing the timekeeper to use a stock time book, which may not provide for cost distribution, a specially ruled time book is provided in which the distribution of labor may be conveniently indicated. Daily or weekly labor distribution summaries are furnished the central office by abstracting the record from the time book.

The time of foremen is charged directly against the work to which they are assigned. The time of service men is prorated to the various operations requiring a part of their time in accordance with the established policy of the organization, generally in proportion to the average actual distribution of the men's time to the several parts of the job, as determined by experience.

The distribution of time and materials is sometimes made by tabulation, but more often by a system of code numbers of general application to highway construction. The tabulation in Table XXVII shows the code system employed by the Minnesota Highway Department and is illustrative of this method. A punch-

card system of records is used in which the items are indicated on a card, the form of which is shown in Fig. 22. These cards are punched in accordance with the mechanical tabulating system and the totals of any item or of any group of items is determined by putting the cards through the tabulating machine.

ACCOUNTING

The bookkeeping incidental to the construction of highways is of two kinds. One is employed by the constructor and will follow the particular commercial system adopted in his office. In general it is identical in principle with the system used in any other business. The supervising highway department will also

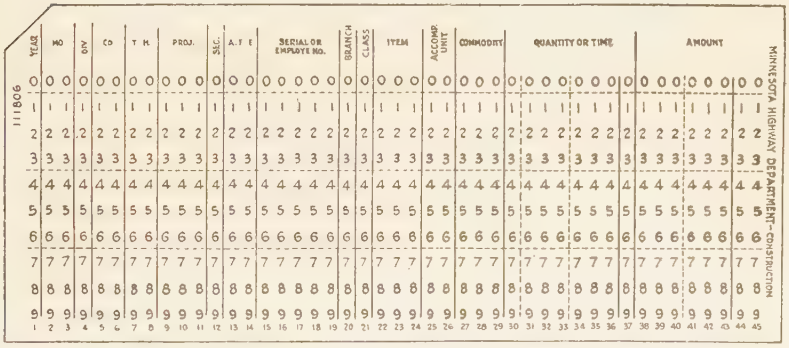

FIG. 22.—Punch card used for mechanical tabulation of costs, Minnesota Highway Department.

keep a set of books or records, but these have the purpose of furnishing a record of the fiscal transactions of the department and will be devised with that particular end in view. It is desired at this place to point out the two kinds of uses to which the cost records are adapted rather than to discuss general accounting methods.

Reference already has been made to the necessity for determining at frequent intervals the profit or loss status of a project. That is vital to the success of any constructor's business.

When a project is undertaken, an account is set up for each unit of work employed in making up the estimate for the work.

The account is credited with a sum obtained by multiplying the total number of units of each kind of work in the job by the estimated unit cost. This gives the estimated total cost of the job. At the end of a checking period, say 1 month, each account is charged with all expenditures that have been incurred on account of that part of the work. The number of units of each kind of work completed and remaining to be completed is determined from the reports of progress. The unit costs are determined for the work already completed and are assumed to hold for the remainder of the job, and the cost of completing each item of the contract is calculated on that basis and credited to the account for that item.

The sum already expended in any account, plus the anticipated expenditure to complete the item, is directly comparable with the credit set up for the account and indicates at a glance the profit or loss status at that stage of the construction. If any account shows a prospective loss, steps should be taken to try to reduce the unit costs for that item, by revising the construction methods.

The value of such a system of accounting is that the constructor can detect a threatened loss in time to do something about it.

At each checking date throughout the construction period, the same procedure will be followed, the actual unit costs being calculated for the items of work completed at the time of the check and applied to the units of the same kind of work remaining to be completed.

At the completion of the job, the final report will show the actual average unit cost for each item of work, and this information will be filed for future reference.

Highway departments are not so much concerned with the profit or loss status of a project as they are with the total actual cost, as distinct from the bid price, and the unit costs of various elements of the construction. They may wish to ascertain the cost of certain units that are wholly different from any the constructor would be likely to use in his accounting. Therefore, they would assemble the costs and units of accomplishment from the daily or weekly reports and compute the unit costs for the whole job. Obviously, if both the constructor and the highway department happen to analyze a job on the basis of the same units, their unit costs should be identical.

CONTROLLING EXPENDITURES

A highway department must know at all times the extent of its financial commitments or it will find itself in difficulties. A system of controlling expenditures, therefore, is set up to insure that the central office has at all times a complete record of expenditures to which it is committed. Various systems are used, of which the one described herein is typical.

Authority for Expenditures.—When a contract has been awarded, a price sheet and copies of the plans and specifications are forwarded to the district engineer who will have supervision of the field work. The district engineer then makes up a request for authority for expenditure to cover the work. This request is based primarily on the aggregate sum represented by the formal contract. Since the estimates in the proposal may have been approximate only, the district engineer makes a new estimate of quantities, based on his knowledge of the site and the working conditions. With this estimate of quantities and the contract prices, computation is made of the total sum involved by the contract. To this total is added the probable cost of engineering, inspection, extras, and an allowance for contingencies. The total of all these items constitutes the sum for which an authority for expenditure is requested.

If it becomes apparent, as the work progresses, that some items will be in excess of the estimate, and that in consequence additional funds must be obligated, a supplementary request of authority for expenditure is filed.

The requests for authority for expenditures are forwarded to the central office, and, if approved, are recorded as committments. The district engineer must carry an account for the job, crediting it with the sums officially authorized and debiting the account with each item of expenditure approved for payment. This system requires that the approval of the district engineer be secured for every disbursement voucher of every kind. Expenditures beyond the sum officially authorized are prohibited.

General Salaries.—The salaries of the regular staff personnel are covered by an authority for expenditure issued to the accounting officer, office engineer, or chief clerk, whichever happens to make up the salary roll.

Surveys and Miscellaneous Field Work.—Expenditures for all field work of every kind, except that carried out by the permanent

staff, are controlled by the same system. The district engineer, or the chief of party, files the request for authority for expenditure in connection with the field work.

It will be apparent that, under this system, the records of the central office will show at all times the financial commitments of the department, and an authority for expenditure will not be issued until it is ascertained that funds are available for the purpose.

CHAPTER XIII

CONTRACT AND DAY-LABOR HIGHWAY CONSTRUCTION

The discussion of the relative merits of the contract system and the day-labor system, as applied to public works, has continued unabated for many years. In the main, the advocates of the contract system seem to have the better of the argument just now, and, yet, among those qualified to judge, there is nothing approaching unanimity of opinion on the subject. No one seriously proposes the adoption of the day-labor system for all public works nor is it proposed to employ the contract system exclusively for the maintenance of streets and highways or for street cleaning. It is urged, however, that the contract system is generally the best for new construction.

It is not the purpose to present herein a brief for either method, but rather to indicate the trend of thought with reference thereto and to point out, it may be, some of the outstanding factors that should be evaluated before adopting the day-labor method, instead of the more generally prevalent contract method, for executing public works. The conditions that prevail in highway construction are the basis for the discussion, although some of the general observations apply equally well to any other kind of construction.

Under ideal working conditions, the day-labor system should be cheaper than the contract system, since the following significant items of cost, as well as certain minor ones, are involved in contract construction and not in day-labor construction:

1. Cost of surety or other kind of construction bond.
2. Interest on money used to finance the job.
3. Liability insurance and workman's compensation, in part.
4. Office overhead chargeable to cost of securing contracts.
5. Cost of moving construction plant, in part.
6. Constructor's profit.

The actual total of the above items on profitable jobs will range from 10 to 25 per cent. Under ideal conditions the theoret-

ical savings should be realized and actually have been realized in some cases. This fact encourages public officials to undertake construction by day labor, when, in fact, all conditions surrounding their project are unfavorable to success.

IDEAL CONDITIONS FOR DAY-LABOR CONSTRUCTION

If the ideal conditions for economical day-labor construction are reviewed, it may aid in gaining a perspective of the problem. To determine whether a proposed project would be prosecuted under ideal conditions is quite another thing. Most of the boards who embark upon day-labor construction probably think their work will be prosecuted under conditions that are sufficiently near the ideal to warrant proceeding on the day-labor basis. In most instances these boards, because of lack of construction experience, are incapable of judging whether the type of work they propose and the nature of the project are such as to offer any reasonable prospect of the economical application of the day-labor method. Some of the more important factors in creating a condition favorable to successful day-labor construction will be discussed briefly in the hope of giving a definite conception of the circumstances under which it might be permissible to undertake it.

Superintendence.—The management of a construction job of any magnitude, on which costs are held to the minimum, requires experience, aptitude, and a world of initiative and energy. The official body that is thinking of undertaking day-labor construction should first ascertain whether it can secure the services of a superintendent who is known to have succeeded on a job of the same kind and size as that contemplated. The fact that a man has succeeded in the supervision of small gangs on street repair work, or in the construction of small buildings or of sidewalks, does not assure his success on a more involved project. When the right superintendent has been found, moreover, a means must be devised for insuring that he will make every effort to produce results at the lowest possible cost. The incentive may be furnished through the assurance of continued employment if he makes a good record, or it may be established through a bonus system of compensation; but, by some means or other, the incentive to do his best must be forthcoming, if the superintendent is to be adequately motivated.

Non-interference.—"Too many cooks spoil the broth" is an old saying that might be well paraphrased into "too many bosses

ruin the job," when one is thinking of the day-labor system on public work. On a successful construction job there can be but one superintendent. He must have absolute authority in every phase of the work. Unless the members of a governing board are willing to pursue a strictly "hands off" policy, they had better not undertake day-labor construction. The temptation to prescribe where materials or equipment shall be purchased, the rates of compensation to workmen, and other similar details of management are almost irresistible to the average public official or board. Very often, they go so far as to decide who shall or shall not be employed on the work. Certainly, these boards have the power to enforce any such working conditions, but, when they do so, they almost invariably make impossible the financial success of the enterprise. In many cases board members will be led to believe that, in the interest of the public, certain materials or certain dealers should be given preference. In this they are generally mistaken, and the only tenable policy is for the board to satisfy itself that the superintendent is competent, and then permit him to proceed without hindrance of any kind.

Labor Situation.—Day-labor construction should not be undertaken where the labor situation is unsettled. If labor is well organized, an agreement as to working conditions and rate of pay should be secured from the proper officials of the labor organization before the work is undertaken. If such an agreement is not forthcoming, there is almost certain to be a strike before the job is completed with costly delays and much bitter feeling.

Labor troubles on day-labor construction inevitably drift into political controversies and result in bitterness and strife in which the economical prosecution of the job and the interest of the public are lost to sight. Each class of labor employed on day-labor construction should be paid the current rate and the hours and the general working conditions should be in accordance with the usual practice of the successful contracting organizations in the vicinity. To do less is unfair to labor and to do more is an injustice to the public that pays the bills.

Equipment.—Mechanical equipment plays an important part in all types of highway construction, and low costs are impossible without the use of appropriate machinery. In day-labor construction, as in contract work, the right kind and quantity of machinery must be used. Herein lies one of the stumbling blocks to economical day-labor construction. If there is a proj-

ect of sufficient size to insure working out the useful life of the major equipment, or if there is a ready means of salvaging the machinery at the end of the job, the equipment cost may be held to a reasonable sum. Sometimes, the cost will not be excessive even when the whole cost of equipment is charged against the work of a single season. The tendency is to purchase too much equipment for day-labor jobs, and then to charge too small a portion of the cost of equipment to the project, in order to show reasonable unit costs. It may be that enough work is projected by the board to insure continued use of equipment over several seasons, and the legitimate charge for this service thereby becomes entirely reasonable. Day-labor construction, however, should not be undertaken until the equipment situation has been analyzed correctly and it is certain that the cost of equipment will be normal.

Type of Construction.—The probability that the day-labor method of construction will be economical decreases as the type of construction becomes more complex. Theoretically, the success that attends this method should not depend upon the sort of work undertaken if the superintendent is competent; but with the more complex types the superintendent will find it increasingly difficult to enforce good workmanship. Unless he has always the knowledge that work which is below standard will be rejected by the inspectors, he is likely to relax somewhat his efforts to secure the best possible quality. Generally, there is no independent inspection of day-labor construction although better construction would result if there were.

Grading and low and intermediate types of road surfaces present no construction difficulties, and consequently there is no good reason for their not being well built by the day-labor method. There is less likelihood of the high-type surfaces and concrete bridges and culverts being satisfactorily completed by that method.

Guide and warning signs are usually placed by day-labor gangs, and nearly all highway and street maintenance is performed by that system, because these kinds of work involve so many variable factors that a constructor could scarcely submit a rational proposal for them.

The day-labor method must of necessity be adopted for any kind of construction that involves extraordinary risks; that is of an experimental character, and may not be susceptible of exact specification; or that involves special methods and equipment

throughout. In the highway field there is very little new construction that falls in any of these groups.

ADVANTAGES OF DAY-LABOR CONSTRUCTION

If it is reasonable to expect that day-labor construction sometimes will be prosecuted under ideal conditions, it remains to decide whether the advantages to be realized are substantial and definite. Many factors present themselves for evaluation in this connection, and which are pertinent, in any case, depends a great deal upon the local situation. Some of the advantages that are mentioned, therefore, may not apply to any considerable percentage of the jobs that are carried out by day labor.

Cost.—Day-labor construction should cost less than contract, as mentioned before. This is an assumed benefit that often fails to materialize, but under ideal conditions it will be realized. It might be well to interject here that the actual total cost of day-labor construction is rarely known, or at least rarely reported. Generally, since the question of financial solvency does not enter into the problem, there is little incentive to keep a close check on costs. Conversely, there is often a political reason for disguising the actual cost.

Control.—Control of the rate of progress of the major work and of auxiliary operations, in the interest of the traveling public, sometimes become exceedingly important. This control is easier to administer in day-labor work than in contract. In some locations it is justifiable to employ a method of construction that involves high unit costs in order to minimize the delay and inconvenience to traffic, and work in such instances is best handled by the day-labor method. There is also complete control of the character of the construction under the day-labor system, if officials provide the right kind of supervision. This is an advantage where the traffic requires highways of the very highest degree of serviceability regardless of unit costs.

Changes in Plans.—Under the ordinary contract system, there is provision for changes in the plans as the work progresses. If these changes are numerous or constitute a wide departure from the specifications, the adjustment of the compensation of the contractor presents difficulties. If he is asked to submit a price for the changed work in advance of its authorization, the competetive element is lacking and the price may be unduly high. If the compensation is based on the cost-plus-profit system, it is

merely day labor under the supervision of the contractor. Under either system of compensation, the sum involved because of minor changes in the plans will be so small a part of the whole cost that no great importance attaches to the fairness of the charges. When major changes are necessary, however, the cost does become a significant factor. Therefore, if any piece of work is projected in a location where the nature of the site or the behavior of materials is doubtful, the day-labor system is probably preferable to the contract system.

DISADVANTAGES OF DAY-LABOR SYSTEM

The disadvantages of the day-labor system arise from the difficulty of establishing anywhere near ideal working conditions. Governmental boards are organized for administrative purposes and not as construction agencies. Ordinarily, they will have neither the personnel nor the background of experience required for success in construction work. The whole situation might be summed up in the statement that, as a general rule, these boards do not know how to secure economical construction and must gain that knowledge at the expense of the public. For that matter, the same thing is true of many contractors, because, while they perform work that is accepted and paid for, that work is not of as high quality as the work of certain other construction organizations.

The most common defect of the day-labor system is the lack of really high-class supervision. There is a strong temptation to assign the management to some individual already in the employ of the department. This person may be a fairly good construction manager and accomplish the work fairly satisfactorily, but it is rare indeed that he will be fully competent. If a superintendent is selected from outside the organization, the board will lack the experience whereby to judge the competence of applicants.

Another very common defect of the day-labor system arises out of the inability of most public officials to delegate responsibility. They seem to find it impossible to entrust the details of construction work to anyone outside their own board. As a result, there is much meddling with the work by public officials and that is highly demoralizing.

Unsuitable equipment is often used on day-labor work because it is thought to be good enough. The result is high unit costs.

Finally, it should be noted again that the urge for financial gain is absent from day-labor construction. A contracting organization must produce profits or cease business, and this is a powerful incentive to apply every economy that can be devised.

ADVANTAGES OF THE CONTRACT SYSTEM

Some of the elements of the contract system have been discussed briefly by way of comparison with the day-labor system, but these need further emphasis. As before, not all of these will be pertinent in any one class of road work, but represent the general experience of public boards who dabble with day-labor construction. They are less likely to apply if the policy continues over a period of years.

Price.—The price at which a specified piece of work will be produced is known before the work is undertaken. This is a very desirable safeguard for work that is to be financed from public funds. The total cost of contract work, of course, is not always definitely known, because changes in quantities may be necessary, or extra work of various kinds may be authorized. These doubtful factors combined constitute a small item in the cost of well-managed work.

Risks.—The constructor bears the risks in contract work, which means that in the long run the public as a whole, rather than a single community, pays the element of cost engendered by unfavorable weather, labor troubles, failures of transportation, financial stringency, and casualties of various kinds. This is eminently fair and cannot be accomplished in the day-labor system.

Inspection.—It is easier for a public board to secure good inspection than it is to provide expert supervision. In contract work the constructor assumes the managerial functions in connection with the job, while the inspection is acceptably accomplished by men who do not have managerial ability or experience.

Investment.—When construction is carried out by contract, the necessity for the public to invest in equipment is eliminated. That sort of investment is always of doubtful economy because the sum of money involved is large and the actual cost for equipment is never known until the used machinery has been disposed of after the work is completed. It is an easy matter for a board to accumulate a lot of junk for which there is no market. The

contracting organization generally has enough variety in its work to enable it to utilize equipment to the end of its economic life and thus reduce equipment costs to the minimum. The constructor generally has contact with a market for the disposal of surplus equipment.

DISADVANTAGES OF CONTRACT SYSTEM

The disadvantages of the contract system arise primarily from the difficulties to which public boards are subjected because the constructor, to whom an award has been made, proves to be incompetent or to have insufficient capital. The inspection will be troublesome and expensive, the work long drawn out, and the results never more than passably good.

All contract work is conducted without very much reference to the convenience of the public, and this despite all sorts of specification provisions relating to this phase of the administration of the contract.

The question of extras on contract work always arises to plague the inspection staff. These are a minimum on work for which good specifications are provided, but in any case constitute an item to be reckoned with. Too often, claims for extra compensation result in long-drawn controversy or litigation.

TREND OF EXPERT OPINION

It seems to be the consensus of opinion that the highway administrative units of cities, states, counties, and townships can scarcely hope to profit by the general adoption of the day-labor method for the construction of roads, pavements, bridges, or incidental structures. The savings in cost that theoretically should result from the adoption of the policy have not been realized on any considerable volume of work. Small jobs here and there do show a saving by the day-labor method, and these serve to encourage the continuance of the policy.

An organization perfected for the administration of contract work is not suited for the supervision of day-labor construction and should not attempt it on a large scale. On the contrary, it should concentrate on the perfecting of methods of inspection and otherwise supervising contract work so as to secure the quality contemplated by its specifications.

Where an organization for supervising day-labor construction has grown from small beginnings, gaining at last the experience

and trained personnel needed for success, there is no reason why the day-labor method should not be satisfactory. There are some notable examples of such highway organizations.

The day-labor method has proved to be satisfactory in those cases where a city or a county has been building a single type of roadway surface year after year and especially when the amount of new construction undertaken each year is too small to attract the better contracting organizations.

A highway department that carries out a large amount of contract work may find it worth while to conduct one or two day-labor jobs each year as a means of perfecting its specifications and to secure cost data for comparison with the prices for contract jobs.

Routine maintenance and miscellaneous construction offer the best fields for day-labor work and these are usually handled in that way.

It is well to repeat that the financial advantages sometimes claimed for the day-labor method of highway construction are likely to prove chimerical, and public officials should not be led into the construction field by estimates that show substantial financial saving to be assured thereby. It is a long way from the inception of a day-labor job to the final accounting, and, generally, it will be found that the expected financial saving has meanwhile dribbled away.

CHAPTER XIV

FORMAL INSTRUCTIONS, PAPER WORK, AND REPORTS

When individuals are associated together in a large organization, there will be those who perform some operation or group of related operations in accordance with a method that has been established in detail by some other person; others will have delegated to them the task of executing some element of the program according to general instructions prepared by someone else; still others will be entrusted with work of such a character that only the nature of the final result is specified, no method of procedure being fixed. For maximum efficiency, the purpose of the organization must be fully understood by each individual employed therein, as well as his particular part in the program; the measure of the effectiveness of each person's work is the extent to which he contributes to the general purpose.

Motivation.—In commercial life, the purpose is to secure a profit on the investment in the business, and the criterion by which any unit of the organization is judged is a financial one. This provides the incentive for each responsible official to direct the affairs under his supervision so as to be able to make a satisfactory financial showing. To be sure, the financial aspect may appear only incidentally, in some departments, the accomplishment being expressed in terms of units of production, or some similar tangible quantity that is directly related to profits.

Highway organizations, like most governmental departments, do not have the profit incentive to efficiency, nor can the public ever know to a certainty whether its highways are being produced at a minimum cost. Indeed, the public rarely knows what its highways actually cost, although it does have some general idea of the relative cost of various types of highways.

The chief of a highway department must check the efficiency of his staff by two standards; one is the quality of the roads and bridges produced, or the excellence of maintenance, and the other is the cost of the work, including all items of engineering and general overhead that are not included in contract prices. He can determine the quality of the product by personal inspection, but

sheer physical limitations preclude his examining more than a small part of the work. In addition, he may require reports that show the results of quality tests, although some properties that contribute to quality are exceedingly difficult to measure.

The cost of the product can be ascertained if appropriate accounting methods are installed.

Classes of Employees.—In the accomplishment of the major purpose of a highway department, which is to produce highways at the lowest cost consistent with appropriate quality, there will be employed the three general classes of workers mentioned at the beginning of the chapter.

The first group consists of those whose duties may be termed routine, or clerical. These are assigned to tasks that are relatively simple, and to which quantity-production methods may be applied. Making and trimming blue-prints and assembling them in sets, performing the sieve analysis on aggregates, indexing and filing papers, and all similar operations are of this group. A great many individual workers are engaged in these activities and they need no special qualifications other than fair intelligence and a certain manual dexterity; but someone must decide how this work is to be done. It would not do to allow each worker, of his own initiative, to devise methods for other than very simple operations; for, if he did, his method would differ from the one devised by each of his fellows, and a chaotic situation would result.

These are facts of general recognition and are detailed herein merely to emphasize that direct supervision is needed for the group of workers under discussion. This guidance is furnished in part by oral instructions and in part by the personal supervision of responsible section chiefs. Written instructions are provided to cover such general subjects as personal conduct, hours of work, vacations, sick leave, and care of property.

The second great group of workers is made up of the subordinate technical staff. These include all employees lower in grade than the bureau and division chiefs. This personnel performs many kinds of work, not only in the central and division offices, but also in the field entirely away from any direct supervision. The changing conditions, moreover, under which the work is performed from day to day, preclude there being inflexible detailed methods prescribed for the guidance of these workers. A certain amount of variation in method and detail is permissible

in the general technical work, but it is obvious that confusion would soon develop if there were not some means adopted to insure reasonable uniformity in method throughout the organization. This is accomplished through the medium of comprehensive written instructions in the form of manuals, bulletins, and memoranda.

The third group is composed of those members of the staff whose work consists primarily in directing and correlating the work of others and, generally speaking, consists of the bureau chiefs and heads of divisions of the bureaus. These are expected to accomplish certain results and about the only formal instructions they receive are general ones with reference to fiscal regulations, expense accounts, and similar matters. Their functions are established by the general policy of the organization, supplemented by conferences with the chief engineer or commissioner, and by programs adopted at staff conferences.

Problems of Management.—The foregoing will possibly give some conception of the managerial problem involved in highway work and create a somewhat tolerant attitude toward those formal regulations that constitute official red tape. The public is inclined to chafe at the delay attendant upon the business that must pass through a highway organization, and yet they would find the same irritating deliberateness in dealing with any one of a hundred corporations.

Every highway organization tries to expedite business and avoid the repeated handling of documents; yet, in spite of all efforts, it is found that a certain routine represents the minimum that is consistent with the thorough consideration of any piece of business. Some departments, of course, never quite reach that minimum, and others employ methods that are exceedingly cumbersome.

The principal aid to coordination is afforded by the formal written or printed instructions that are issued to the staff. These vary in subject matter and completeness according to the purpose and the group of employees to whom they are issued.

General Instructions.—General instructions are those applicable in whole or in part to all members of the staff. They contain the rules of the department relative to personal conduct, hours of labor, vacations, sick leave, methods of requisitioning supplies, regulations applicable to travel at public expense, the use of motor transportation, and a host of similar subjects. The

purpose is to insure, as far as possible, an orderly, systematic, and uniform procedure with reference to the conduct of the business of the organization and the same industriousness on the part of employees that a private employer would exact.

The proper attitude of the employee toward his real employer, the public, is emphasized in many of these instructions with but little effect in some cases, one would surmise. Yet, this matter of personal conduct and responsibility to the public is so important a matter that it is emphasized repeatedly in formal instructions, and employees are informed that if they are habitually discourteous or dilatory, summary dismissal will follow.

In the preparation of general instructions with reference to personal conduct, there are two guiding principles: One is to insure that the provisions of the law with reference to his status as a public agent are brought to the attention of the employees, both those that restrain his activities and those that emphasize his privileges as a citizen, being included. The other is to state the department (and usually this means the chief engineer or commissioner) policy with reference to the several phases of the employee's work. It is with reference to this latter part of the general instructions that employees sometimes make complaint. Perhaps the established rules sometimes fail to take advantage of the teachings of psychology, and therefore create a situation in which the instructions may be followed to the letter but be largely disregarded in spirit. On the whole, the manuals of instruction that have been reviewed are very evidently intended to motivate the staff to a recognition of the dignity and honor of public service, and to secure enthusiastic cooperation between individuals.

INSTRUCTIONS TO FIELD PERSONNEL

The field men are engaged in some special kind of work, such as location surveys or the inspection of construction, and are on their own responsibility for days at a time. They may obtain advice from district engineers in a few hours, if at any time that is necessary; yet, for the most part, they are expected to get along with no more than an occasional conference with their superiors. The work they are performing, moreover, is of such a character that no set of instructions can possibly cover every contingency that arises. The usual formal printed instructions, therefore, seek to do no more than provide for a uniform procedure by all employees engaged in any one kind of field work.

Frequent changes in personnel are to be expected in a large organization, and the men who are newly appointed are usually assigned to the field without having an opportunity to learn a great deal about the headquarters organization, or their superiors in the particular division they serve. In some way these new employees must be instructed in their duties, which generally devolves on the district engineer or the resident engineer. While the immediate work can be explained, it would be wholly impossible to take time to tell the new men all about the organization or to explain in detail the various reports that must be filed and the records that are to be kept as a part of the routine of the position. So these details are explained in written instructions, together with the personnel of the organization, the responsibility and authority of the various men, and the location of district offices, general offices, and laboratories.

Location.—The instructions, with reference to the location of highways and making the surveys from which plans are to be prepared, outline the several steps that must be taken if the projected improvement is to be in the best possible location or the paving of a street to be designed so as to fit the existing right of way in an acceptable manner.

Each type of survey that may be assigned to a party is outlined in detail, and the duties of the members of the party are fully explained. The chief of party is assumed to know how to adjust and use the instruments, keep records and survey notes, and check the accuracy of his work. He is also expected to know when it is necessary to modify the standard method of surveying in order to secure pertinent data. There are many acceptable ways of keeping field notes, setting station and grade stakes, bench marks, and reference points for hubs. Some one method must be followed throughout an organization, so that future reference to the survey notes and field monuments can be accomplished without loss of time. For these reasons, each department has a standard method, which is explained fully in a printed manual.

The kinds of periodic reports that are to be submitted by survey parties vary considerably in different localities, so there must be included an explanation of the report system of the department.

The type of instructions furnished to engineers on location is indicated by the following extract:

HIGHWAY LOCATION[1]

The work of highway location with relation to modern traffic is something which is so new that the schools have not grounded the student in any of its underlying principles. Railroad location is well studied and many graduates of technical schools have practical experience in that work. Few students have that experience in highway location, although their number is growing yearly. The romance and importance of the railroad-location man has been played up so strong that its glamour has greatly overshadowed the highway work. Yet, the annual expenditure on highways is already far in excess of the annual sums spent on railroad work in its palmiest days. Any knowledge of railroad engineering is valuable in highway work if the engineer can correlate that knowledge with the requirements of highway location. Until within the last very few years, highways have been built with too little regard for the necessity which modern traffic demands for safety and speed.

The highway system of the state is analogous to a great railway system, with its main lines and branches, with its double and single track. The same principles are met with in location; the problems are statewide, and not local, in most instances. The same general principles govern in the details of construction. The organization of the state highway department of Michigan is similar to that of a great railroad with the taxpayers as the stockholders, the highway commissioner as the president and general manager. There are departments of engineering and operation, with a chief engineer and a headquarters engineering staff. The resident engineers are the division superintendents of the railroad. The business of the whole organization is to provide travel ways for the public which are as short, as straight, as safe, as easy to travel, and as speedy as the various limitations will permit. The profits or returns on the vast sums of money spent will depend upon the efficiency of the expenditure and may be measured in terms of the benefits to the traveling public.

If the highway engineer will study the map of the state trunk-line system and compare it as above, he will see the reason for the long preliminary surveys which are now being made. The small links of the great system which are built each year must fit into the general scheme, as a highway construction project so located that it does not stand the test will compromise the department when different conditions make the larger project possible.

The field of highway engineering is rapidly progressing, and the highway engineer must be ever alert to the situation and must be able to foresee future developments. The attitude of the general public has considerable weight in highway work, but if the department is not con-

[1] "Highway Location and Surveying," p. 13, Michigan Highway Department, 1925.

siderably in advance of present requirements and does not arouse some criticism because of that, it is certainly not functioning to its greatest worth.

Materials Inspection.—The exact method adopted by an organization for conducting materials inspection will depend to a considerable extent on the nature of the construction and the types of materials involved. Each department, therefore, works out a system appropriate to its conditions. While the methods of sampling and testing materials are almost identical in all highway departments, whether they be federal, state, or municipal, the time and place of testing supplies and the frequency of testing necessarily will be varied in accordance with a good many factors. The system adopted by a department is explained in the instructions to its materials inspectors, along with the standard method of testing. The details of packing and shipping samples are prescribed, and directions given with reference to reports and correspondence. Each stipulation in these instructions has a well-considered purpose and should be observed with fidelity.

Construction Supervision.—The specifications are the basis of construction inspection and these ordinarily define the duties of the inspector. In addition, the inspector is furnished written instructions that explain how he shall go about his duties. The clauses establishing his authority are quoted from the specifications and explained in detail, the specific functions he is supposed to accomplish are enumerated, and he is given a great deal of advice as to how he should proceed with his work. Nearly every highway department has certain special methods of checking the accuracy of the work of constructors and these are detailed, as well as the tolerances allowable in the various quantities that are checked. An important part of the instructions to inspectors has to do with their attitude toward the constructor's organization and the public. This is illustrated by the following extract:

GENERAL INSTRUCTIONS TO ALL INSPECTORS[1]

Don't carry a chair. A good inspector wears out the knees of his trousers and the soles of his shoes.

Be friendly with everyone on the job; familiar with no one. Familiarity dulls the edge of an inspector's authority.

[1] "Construction Manual," p. 105, Minnesota Highway Department, 1925.

Be courteous to visitors. Future construction depends upon public good-will. Do not prejudice the public against road improvement by flippant answers to what may seem to be foolish questions.

Orders should be given to foreman, superintendent, or contractor only. This rule does not apply to things of minor importance, such as the correction of form alignment, elimination of a high or low spot in the subgrade, or other routine matters. In such things it is proper for the inspector to call the defect to the attention of the workmen responsible for that particular part of the job.

Do not waste workmen's time by carrying on a conversation with them.

Be severe at the beginning of the job. An erroneous method is more easily corrected the first time it is practiced than after it has been in use, and the reputation of being slack or "easy," though it is quickly attained, is hard to overcome.

An inspector usually enforces his commands through personality. Be sure your judgment is so cool, fair, and impartial, and your knowledge of the work so thorough, that you command respect and obedience.

Don't argue. Refer disputed questions to your superior, and until you hear from him, use your own best judgment.

Aid the contractor at every opportunity, so long as it does not affect the quality of the pavement adversely.

The first batch of the day is the one most likely to be bad. Be there to see it mixed.

The last work of the day is most likely to be poorly finished. It should be checked before you leave.

Do not try to magnify your own importance by telling outsiders of the errors you have corrected, or of the crooked work you have uncovered. The quality of the completed pavement will measure your ability and will be your strongest testimonial.

Proper inspection is a man-sized job. It requires constant vigilance, diplomacy, and good old-fashioned backbone. Good inspection may add several thousand dollars to the value of the road without adding materially to its cost.

Responsibility.—All inspectors assigned are under the direct supervision of the resident engineer. It is the inspector's duty to see that all requirements of the specifications as to materials and workmanship are strictly followed. Should there be any special reason for making any changes, the inspector should consult the resident engineer. The inspector is not permitted to allow any deviation from plans or specifications.

Familiarity with Plans and Local Conditions.—Carefully study all plans, elevations or other drawings, and also all specifications and see that the drawings are in conformity with each other and with the specifications.

Familiarize yourself with all local conditions or ordinances affecting the work, and see that the same are rigidly adhered to.

Establish diplomatic relations with the adjoining property owners or residents, and see that all their rights are respected by the contractors.

In much the same way, the duties and responsibilities of the resident engineer are covered by written instructions. The preferred method of staking out work and giving elevations and lines is outlined, and the pitfalls which are likely to confront the engineer are described.

Nearly all instructions of this type emphasize the ever-recurring necessity for the exercise of good judgment and painstaking attention to detail, as well as an uncompromising attitude toward any infringement on the provisions of the specifications.

Some of the instructions to resident engineers are very complete handbooks of construction, with tables and diagrams that will be found very useful in the various technical activities involved in construction work.

The following abstract is typical of the general instructions to resident engineers:

RESIDENT ENGINEER[1]

Section 1. *Duties:* The resident engineer is the direct representative of the California Highway Commission. He should be friendly and courteous in all of his dealings with the people of the locality and with the traveling public regardless of their attitude toward him and should always bear in mind that the Commission is judged by the conduct of those who represent it.

The first duty of a resident engineer is to efficiently and honestly perform the duties assigned to him, especially that of seeing that the work is executed in full accordance with the plans and specifications. These duties, performed with the object of securing for the state a completed work in which materials, workmanship, and finish are in strict accord with the plans and specifications, should be performed in a businesslike and ethical manner, with an unfailing tact and courtesy that will convince the contractor that a spirit of fairness is the basis of all of the Engineer's orders.

Unreasonable demands imposed upon contractors by impractical resident engineers occasion loss to the state. Contractors who feel that they have suffered at the hands of such engineers, often refuse to bid again upon state work. Others bid higher in apprehension of having an unfair engineer assigned to the job.

[1] "Manual of Instruction," p. 28, California Highway Commission, 1925.

At the first opportunity the resident engineer should read over the specifications with the contractor and interpret them for him, especially the construction details and special provisions. It should not be assumed that the contractor is thoroughly familiar with the specifications, nor that he knows how you expect the work to be done. It is far easier usually to reach a mutually satisfactory understanding in the beginning than to wait until the work is partly completed.

A diary should be kept up to date. It is best to carry it while on the work, and during the day make entries of conversations and statements bearing on the work, instructions given, materials received, and other important items.

The engineer is most successful, and his service of most value to the state, who can secure strict compliance with the specifications, and maintain such agreeable relations with the contractor that he will be anxious to bid on other work. The success of the construction may hinge upon the proper performance of what may be considered minor features of the work. In case of faulty construction which results in loss of life, the engineer may be guilty of contributory negligence.

The resident engineer shall be at the work at all times when it is in progress. He shall read and check off all dimensions and notes on the plans, and list all special requirements in connection with the work to which they apply. When in doubt, he shall obtain instructions from his supervisors sufficiently in advance of the time when needed to avoid delay.

Highway Design.—The utility of design standards has been mentioned in another place. Standard specifications are prepared to establish the basis for design, and drawings are made to show standard types and standard details. It then remains to explain how these are to be applied, the size of sheet to employ for each class of design, the scales to use, the kinds of lettering, weight of line for drawings, and similar technical details. Since designers usually work in squads under an experienced designer, the problem of supervision and coordination is much simpler than for men who work in the field. Even under these favorable conditions, written instructions are found to be very useful and are widely used.

PAPER WORK

The preparation of periodic reports and requisitions, payrolls, reimbursement vouchers for expenses, partial payment estimates, and similar routine specialized clerical work comprises an important and indispensable part of the duties of both the

technical and the non-technical staff of a highway department. Some of the records required are necessary because of provisions of law and some are a part of the system of control set up in the organization.

The administrative officers of a highway department can keep in touch with the affairs of their organization only through the routine reports that are required on the activities of the department. An executive, moreover, never could be sure that he would receive complete reports if he did not specify the form in which they are to be made up. The simplest way to get reports that include all the information that is desired is to require the use of appropriate forms in submitting the information. When a district engineer finds it necessary to transfer an inspector from one job in his district to another, the central office must have a record of the transfer in the form of a report from the district engineer; but the district engineer may not know exactly what information the central office requires to be able to follow up the man, so a form is prepared upon which the report is to be submitted. On that report form are instructions which enable the district engineer to accomplish the report in a proper manner. When the report is made out as directed, it is complete and is on a sheet that is of convenient size for filing.

Substantially the same idea is back of the numerous forms employed in every highway organization. Forms serve to standardize the transaction of routine business and to reduce to a minimum the labor of preparing periodic reports.

A certain state highway department provides for no less than fifty-four different kinds of reports from field men on various classes of work. No one engineer will be required to prepare such a number of reports on any one job, but, in the course of a season, he may have occasion to make up a score or more of different kinds of reports, and many of them will be made up weekly or monthly.

SPECIAL AND GENERAL REPORTS

Special reports of various kinds are repeatedly required of all grades of technical employees of a highway staff. These range in complexity from the very simple letter reports to those that comprise a sizable printed volume. Reports of this type are wholly different in character and purpose from those routine reports that are submitted in standardized form on blanks pre-

pared for the purpose. The routine report, like a payroll or construction progress report, is a part of the machinery developed to care for the normal work of the organization. The special report is employed when conditions arise that are not covered by standard practice or by written instructions, or to secure information with reference to new projects or in response to complaints.

It is the rather general experience of executives that special reports fail in the quality of completeness in too many instances. If decisions must be arrived at on the basis of a report, the official who must act likes to feel that all salient features of the question are before him. Ability to prepare complete, concise technical reports is an asset of considerable value. It is a good rule to include in any such report all data that can by any chance throw light on the question at issue. The writer of a special report should always remember that while he has had time to study the subject from all angles, the executive can scarcely do more than read the conclusions or recommendations and perhaps scan through the main argument.

These special reports are of many kinds, but they fall into a few fairly well-defined groups.

Preliminary Reports.—The preliminary investigations that precede the establishment of highway projects are generally of standard and routine nature and are handled by means of form reports; but a study of these form reports will sometimes indicate the need of additional information with reference to some phase of the situation and an engineer will be assigned to make a special report on that particular part of the project. This may deal with some technical subject such as materials, drainage, structures, or location, or it may deal with finance, administration or public policy. Reports of this type follow the usual form of technical reports, being either letter reports or long formal reports, according to circumstances.

Complaints.—Highway departments receive a good many complaints of one sort and another. Some are trivial and may be answered without special investigation, but others raise questions that require some study before a decision is made as to the disposition of the complaint.

Report on Failures.—Every highway department has its quota of failures, although these involve a negligible percentage of the work accomplished. The lessons to be learned from failures are most valuable and every wide-awake department

seeks to profit to the utmost from them. They are usually recorded in the form of special reports, which obviously should be exhaustive and comprehensive. The investigator who studies a failure will need to exert the most determined effort to avoid arriving at conclusions that are based on the opinions of others, rather than on the weight of evidence uncovered during the investigation. In many cases the causes of failure never will be positively ascertained, but a record of all attendant circumstances will nevertheless assist in avoiding a repetition of the conditions.

Reports on Construction Methods.—From time to time, special inspectors are sent out by the executive officer of a department to study in detail the results of adherence to the construction methods provided for in the standard specifications. The reports of these special inspectors serve as the basis for modifications in construction practice.

Reports on Research.—Most of the highway departments conduct research, some of which is of a minor character and some is in connection with a subject of a very involved nature. The reports of minor projects usually will be presented in typed form as ordinary technical reports and perhaps later summarized in some technical journal or in a publication of the department. Reports on major investigations are generally published in bulletin or pamphlet form. Reports of researches constitute an important source of technical information. They cover many phases of materials testing, the use of materials in various structures, traffic studies, service records, construction, maintenance methods and many phases of highway finance and administration.

General Reports.—Highway departments are required to make periodic reports to the governing body, and these vary greatly in scope and composition, but have one characteristic in common. They are dry reading for anyone who is not interested in evolving a story out of the mass of statistics and technical data. These data are the foundation of technical progress and should be preserved in printed form, which is one reason for the publication of reports of this type.

Some departments prepare the report in two parts, the one being a short, non-technical summary of the work accomplished in the period covered by the report, the other being the usual detailed statistical and technical report. The first part is suitable for publication by newspapers, or at least can be readily

edited into form suitable for such publication, and ought to appear in every department report. The second part is of service to the technical organization, and is probably used but little except in connection with technical studies.

House Organs.—The house organ originated in commercial organizations as a means of disseminating information among the members of a numerous personnel. The idea has been adopted by many highway departments, which publish a monthly magazine that circulates among the employees and is supplied to anyone outside the organization who cares for it. Some of these magazines are of a high order of merit and carry a quantity of excellent technical material as well as a mass of general information as to the activities of the department. The magazines are generally profusely illustrated, well printed, and edited with a view to retaining public support for the program of improvement under way in the state or city. The cities have made much less use of this idea than have the states, probably because the newspapers, through their own staff, secure and publish a mass of general highway news each year.

CHAPTER XV

THE FIELD OF HIGHWAY ENGINEERING

The development of highway transportation methods and equipment in the United States since the year 1900 has been of truly amazing proportions. In a quarter-century the accomplishments have far exceeded those of the whole previous national history. In so short a time has the nation outgrown all precedents for road building and embarked on the program of constructing the most ambitious of state and national highway systems. Every city of any consequence is trying to envision the traffic of the future and to provide for it.

Design of highways, methods of construction, the practice in combining materials into roadway surfaces, and the skill and resourcefulness required of constructors and supervising bodies, all have made gigantic strides in a single generation. So swift has been the pace and so complete the transformation that there is no general realization that a new science of road building is in the making.

The establishment and improvement of a modern state highway system, or the arterial street system for a great city, involves so many questions peculiar to the science of road building that technical supervision of highway construction aids greatly in securing an adequate and economical solution for the multifarious problems that arise at every state of progress. The successful administration of the activities of a highway department of any significance is becoming increasingly dependent upon its ability to command the services of an adequate technical personnel. In many states the administration of the highway department is actually in the hands of technically trained men, while in most of the others the technical staff has considerable influence on the administrative policies. The reason will be apparent when the character of the activities of a modern highway department is understood.

Types of Technical Problems Involved.—In selecting and laying out a system of streets or of rural highways, certain

questions of a social and political nature will arise, but the final selection must be based largely on an understanding of the engineering problems involved in the improvement of the various possible routes. Aside from the considerations of public policy encountered in the administration of highway systems, there are few activities of a highway department that are not predominately technical in character. Traffic studies, surveys, designing roads and bridges, supervising construction, testing materials, and research, all are the regular routine of a busy highway department and constitute its principal reason for existence.

It will be of interest to note the extent to which the several phases of highway administration involve strictly engineering problems or are directly affected by some factor of an engineering nature.

Materials Problems.—The materials that are used in road surfaces are subjected to destructive agencies differing in character and intensity in many ways from those to which other engineering structures are exposed. Road materials, therefore, must be tested and evaluated in a special manner. This requires a knowledge of the exact properties materials should possess if they are to have maximum serviceability in highway structures, as well as of special tests that have been developed for determining which materials are best adapted to the service. The testing of highway materials has become a complicated and highly specialized profession.

Types of Construction.—Numerous types of structures and roadway surfaces have been gradually evolved to meet the requirements of highway service. Through long usage certain of these have become standard in composition, while others are varied in composition through wide limits to meet the necessities of the location.

The familiar types of roadway surfaces—such as brick, concrete, and asphalt—appear to be of standard design and construction, but in reality each is put together in many different ways with a resulting limitation as to traffic capacity and suitability for a particular service. Familiarity with the inherent properties of the many variations in these types is necessary to insure the selection from among all the designs available for a specific project, the particular combination of materials that will prove most economical.

A wide range of types of highway bridges are employed in the United States. Structures of this character are susceptible of rational design and any type may be designed so that it is safe for the loads expected, but all are not equally desirable from other standpoints. The question of relative costs, of sightliness, and of durability enter into the selection for any specific location, and the most satisfactory type can be adopted only after an exhaustive analysis by someone who is versed in the technique of bridge and culvert design.

Contract Practice.—A very large proportion of the highway improvement in the United States is carried out by contract. Contract work is always based on written specifications, which are usually exceedingly complex and elaborate.

A suitable set of specifications for highway or street improvement must comply with the laws and ordinances in the governmental unit in which the work is located. The legality of the contract and of the financial commitments involved, will depend upon the fidelity with which the specification requirements conform to state and federal laws or municipal ordinances. There is also a considerable volume of law relative to contracts which has been established through the decisions handed down by the courts from time to time. These must be fully understood and their relation to the work in hand weighed when the general provisions for specifications are being drafted.

The portions of the specifications that elaborate the details of the construction can be prepared properly only when the specification writer is familiar with the accepted methods of construction for the particular types covered by the specifications. A specification, moreover, may include all the requirements of good construction, but does so in such a manner as to increase greatly the difficulties of the contractor and thereby affect the cost of the work adversely.

The preparation of well-balanced specifications is an exceedingly complex task, involving familiarity not only with the laws on the subject, but also with the best practice in the actual construction of highways.

Necessity for Technical Service.—The varied activities outlined in the preceding paragraphs emphasize the important part that specialized technical knowledge plays in the conduct of the affairs of a highway department. This serves to indicate the type of service that is being rendered by the expert who under-

stands current highway practice with respect to the design and construction of roads and pavements, the testing of materials, and the writing of specifications.

The lack of full appreciation by officials and the public of the indispensable service rendered by the technical personnel in the various highway departments constitutes one of the disturbing elements in our system of highway control. It is not uncommon for elective officials of undoubted attainments to exhibit the utmost unconcern over vital technical questions, a situation that can be explained only by their total inability to grasp the significance of the technical points involved. As for the great mass of individuals who constitute the tax-paying public, they are, of necessity, so engrossed with their own affairs that they hardly can be expected to give thought to problems of this sort, or even to realize that problems exist.

It would be well if the engineer in public service would do a judicious amount of professional (not personal) advertising in his community to force upon at least some small part of the public a realization of the part that engineering plays in the development of highway transportation facilities.

Administrative Duties.—The engineer who attains any considerable degree of responsibility in the highway field should have administrative ability, because he probably will be required to plan and supervise an organization for handling the work with which he is charged. This is unlikely to devolve upon the engineer who is just starting his career, but it is a part of the work of the engineers who reach the more exacting positions and must each year supervise the construction of improvements on a considerable mileage of highways.

In a county in which a comparatively small amount of road surfacing is being accomplished, the problem of administration is a fairly simple one. Probably the engineering force will consist of the county engineer and two or three assistants whose duties are easily understood. Occasional verbal instructions to these assistants will be all that is required to keep them working effectively and to insure prompt attention to the special problems that arise.

If a county contains a large city, and the county is engaged in an energetic campaign to provide the feeder roads necessary to serve the city, the county engineer is likely to have an organization of considerable size. The administrative duties of the

engineer in such a county will be exceedingly exacting and will require a considerable amount of time and energy. Poor management of such an organization will result in waste, inefficiency, and friction, and the incumbent of the office will find himself greatly handicapped if he has not attained some proficiency in administrative work.

The annual construction program that is supervised by a state highway department usually involves the expenditure of several millions of dollars. A large number of constructors will be engaged on the work, and the engineering organization will consist of 200 or 300 men of various grades. The administrative functions of the head of such an organization become of paramount importance. Roads must be surveyed, locations adopted, and all other preliminary work involved in the design of the road must be completed. Then, plans and specifications are to be prepared, the work advertised, and contracts let. The inspection of the construction and the testing of materials must go along systematically with every precaution being taken to insure that nothing escapes the inspectors' observation. All this must proceed in an orderly fashion in accordance with some established system which will provide for all contingencies that may arise in an organization with widely scattered activities.

It is quite likely that, in addition to the construction work which is being carried out by contract, there will be a considerable amount of day-labor construction to supervise. This may be performed by gangs that are really a part of the permanent organization, or there may be gangs organized solely for carrying out specific pieces of work. Construction gangs may be working on earth roads or on some type of hard surfacing, or they may be engaged in the construction of culverts and bridges. Whatever may be the kind of work, it must be supervised properly and an accurate check kept on the rate of progress and on the cost of the work.

A very considerable proportion of maintenance work on public highways is accomplished by day labor rather than by contract. It is sometimes performed by a single patrolman who takes care of the maintenance of a few miles of road; or, it may be carried out by sizable gangs that are equipped for the more elaborate maintenance operations. The character of the work encountered varies from the simple operation of dragging an earth road to the complex one of maintaining hot-mixed bituminous surfaces.

Work that is so diverse in character and that is being carried out simultaneously in all parts of the state will require the closest supervision if results commensurate with the expenditure are to be obtained. This supervision not only must secure faithful service but also must insure that the right materials and methods are used.

The engineer will use some clerical help, the size of his office staff depending upon the volume of construction and maintenance work under his supervision. The office activities usually include the purchase of supplies and equipment, the auditing of miscellaneous bills and construction estimates, the handling of payrolls for office and field employees, and of correspondence on many subjects. Generally, there is some office routine involved in the handling of plans, specifications, estimates, reports of tests of materials, and similar strictly technical activities.

There is at times a drafting-room organization engaged in the preparation of plans for roads and bridges. This is likely to require a considerable personnel in a state organization or a municipal public works department. This force must be organized and supervised, and a system of routing set up so that specific plans can be followed through to completion, with adequate checks on the accuracy of the work, and with a system of filing which will enable clerks to locate plans and other documents on short notice.

The record of construction activities is not complete unless it includes the cost of the work, and the highway organization for the state will of necessity include provision for the assembly of statistics of the cost of construction and maintenance, including records of contract prices and of costs of materials. The cost of engineering and inspection should be ascertained and analyzed from year to year, so as to afford a check on efficiency. The supervising engineer may not be an expert in cost keeping, but he often will be held responsible for the organization of that work and must know when it is properly accomplished.

All of these miscellaneous activities involve administrative duties and indicate the opportunity for a good manager to utilize this special ability in securing a smoothly running engineering staff that can produce results at minimum expenditure.

Efficiency Studies.—The highway organization that goes serenely along from year to year, in the firm conviction that its methods are above reproach and its costs well within the limita-

tions imposed by its working conditions, is at some time sure to receive a rude awakening. Legislators and those sometimes obnoxious gentlemen known as investigators have a habit of occasionally undertaking to find something wrong with a department that is maintained by public funds. The only way in which an organization can be prepared for such a contingency is for the administrative authority to cause occasional efficiency investigations to be made on his own initiative. Such investigations will reveal the defects in his organization, if any exist, and make possible corrective measures before serious financial loss occurs.

It is also a trait of human nature that the sum of human knowledge on any subject is seldom reposed in any one group of men, and it is highly improbable that any highway organization can acquire all information to be had on the work in which it is engaged, unless continuous contact is maintained with the work of other organizations of similar purpose. Investigation of the methods of others is a fairly certain preventive of abnormal self-conceit, and willingness to adopt new methods or materials as rapidly as they become established is a prerequisite to departmental progress.

Financial Problems.—The highway administrator will have continual contact with financial problems of considerable magnitude. The cost of highway construction is frequently paid from funds obtained though systems of taxation that are not really equitable. So long as such taxation does not become burdensome, it will not be the cause of special public complaint, although general complaint about taxes is always to be expected. As the volume of highway work increases, as it surely will, the financial burden will be so great that the demand for equitable methods of financing will become insistent. The highway engineer who is able to devise a system of finance for his program that will spread the cost of construction in an equitable manner, renders a great service to the community in which he works. Who should be better able than he to appraise the probable zone of benefits from an improvement?

When the required funds have been secured, the problem is only half solved. The funds must be invested in highway improvements, and the conditions under which public service is rendered make it exceedingly difficult for an administrative authority to obtain a dollar of value for a dollar of public money.

Careful financial planning and a most rigorous supervision of expenditures are necessary to prevent waste or extravagance.

Social and Economic Problems.—Social and economic considerations enter into many of the problems incident to all highway improvement. It has long been realized that there is a definite relation between highway improvement and rural health and happiness, and this fact can be capitalized into the good-will of those who live in the rural districts and must pay taxes in support of highway construction.

There is likewise, a very definite relation between highway improvement and rural educational progress. The day of the one-room schoolhouse certainly is passing and some better educational system must be devised for rural children. Any system that meets this need will depend upon good highways.

Free social intercourse among the residents of rural communities, and between such residents and those of the cities and towns is a prerequisite to a healthy social life for those who live on the farms. This is also helpful in creating an environment that will be attractive to the type of agricultural population that will be able to meet successfully the problems of the farm industry. Good public highways are a prerequisite to such opportunities.

Agricultural prosperity is affected to a marked degree by the cost of marketing of farm products, and this cost is dependent upon the nature of the highways over which the products of the farm must be hauled and the faithfulness with which these highways are maintained at maximum serviceability. Herein lies one of the great economic possibilities of highway transportation and one that is now being widely recognized.

These and many similar considerations have a vital relation to highway progress. Leadership in promoting a sane program of highway development in any community is most likely to fall to the one who visualizes the numerous economic and social influences of highway improvement.

Publicity Problems.—It would be fortunate if in each community there were someone who would actively promote a rational sentiment toward highway improvement, because real progress is impossible without public support. There are many individuals who, for personal aggrandizement, are attempting to promote selected highway projects or highway routes. Probably these professional promoters have occasioned the expenditure of millions of dollars upon projects which are ill-advised although not

all were worthless. The technical expert should be able to show the fallacies in the vicious or uneconomic promotion schemes that are advanced in his community.

There is also a class of honest and sincere individuals who are continually advocating some visionary scheme for highway improvement. Well-meaning though they be, waste of public funds would result from the adoption of their plans and the engineer who is alert to the best interests of the public will point out the defects in those proposals that are clearly inimical to good public policy.

The rapid progress now being made in the art of road building and maintenance has been mentioned. It is the duty of the highway engineer to keep his community informed of significant improvements in construction methods and the development of new materials or processes in the highway industry. He should be a leader in promoting all worthy and practical schemes for highway betterment, and by so doing should constitute himself the recognized highway authority among the people he serves.

Personal Relationships.—The highway engineer, in many of his activities, will come into personal and official relationships with other public officials, and his dealings ought to be fraught with such courtesy and consideration as to insure their cooperation in matters of common interest. Few individuals are so fortunate as to be able, of themselves, to dominate public policies; most men need public and official support at times, and ought to deport themselves so that other officials will be glad to help them render effective public service. Personalities will always enter into these official and public contacts, it being comparatively easy to deal with some men and exceedingly difficult to deal with others. Some will be likable, efficient, and willing to render every possible assistance. Others will be of disagreeable personality or of a selfish disposition, and unwilling to cooperate unless doing so will advance their own interests. Usually a way can be found for dealing with each, and this way must be found if the engineer is to make the greatest success of his work.

The man who heads any organization will have constant personal contact with his subordinates, who will differ greatly in their mental characteristics, in their personality, and in their abilities. Each man will be most efficient when dealt with in a sympathetic and inspirational manner, and the administrator who does not seek every possible means of bringing out the best in his

subordinates is overlooking one of the greatest aids to his own success. The subordinate, likewise, who helps his superiors to progress will himself be carried along and thus achieve advancement.

Public Relationships.—The engineer in public service will frequently meet his employer, the public; meet him individually and on an intimate footing. Sometimes, it will be a man of outstanding influence in the community, but more often it will be the ordinary citizen who is simply one of the mass. In either case, the meeting presents an opportunity to make that man his friend and a friend of the highway department. As highway departments are now organized, the staff members are, first of all, public servants, and the public consists of individuals each of whom is entitled to every consideration in any legitimate inquiry or request.

The engineer in any subordinate position must appreciate that due respect, and consideration for the policies of his official superiors is fundamental. Each board of elective officers, appointive commission, or board of public works, is entitled to absolute loyalty from each employee. The men making up such boards are often unfamiliar with the technical side of highway engineering, and they may not even understand thoroughly the business side of the highway problem. In any case, it is always only fair to make every effort to put technical problems before them in such a manner that they will understand the true import of the matter, and seek to protect them against the results of unwise or hasty decisions.

Professional Enthusiasm.—In the foregoing there have been mentioned some of the many phases of the practice of the profession of highway engineering, for the purpose of indicating factors that make for success in that field of endeavor. Even the possession of all the numerous attributes suggested (and there are few men so endowed) will not equip the individual for the greatest success, unless back of it all there is a keen realization of the dignity and honor attainable from constructive work that is well done and which contributes to human progress. Usually, the financial return from public service is moderate but fairly certain, and if the engineer possesses the vision to serve the public wholeheartedly, in spite of the manifold discouragements that will beset his efforts, he can be reasonably sure of ultimate professional recognition and possibly of public recognition and reward.

The field of the highway engineer is preeminently one requiring a combination of technical skill, administrative ability, and high professional ideals. Such an one can find no field of usefulness fraught with greater opportunities for honorable, constructive, and fruitful public service, nor one that contributes more to the health, happiness, and economic progress of the nation.

MINIMUM SPECIFICATIONS FOR HIGHWAY ENGINEERING POSITIONS

In 1923 a special committee of the American Association of Engineers presented a report[1] embodying recommended minimum specifications for highway engineering positions and these present in a most admirable way the skill, training, experience, and personal qualifications required for success in the various classes of highway engineering positions. For that reason they are included herein. It will be noted that only the more usual kinds of work are covered and that each specification is given under a heading that is the usual designation for the class of service.

Chainman—Rodman

Skill.—Under immediate supervision, to clear line or survey, measure distance with chain or tape, hold level or stadia rod, drive stakes for line and grade, establish bench marks, pitch and take down tent, pack and unpack equipment, make simple field sketches and field computations, index field books, and perform such other simple engineering duties as may be required of an aid or helper on survey work.

Knowledge.—Fair command of the English language.

Care of simple surveying instruments, such as chain, tape, level rod, stadia rod, plumb bob, etc.

Sufficient working knowledge of arithmetic, algebra, and geometry to perform the requisite skills.

Personal.—Good physique, active and alert.

Have sense of direction and location.

Instrumentman

Skill.—Under supervision, to run lines, make layouts of structures on ground, determine elevations, do cross-sectioning, locate property corners, and do such other instrumental work as may be required for highway location, construction, and maintenance.

Take field notes and make the necessary computations and sketches.

Act as assistant in office.

In absence of Chief of Party, take charge of survey party.

[1] National Research Council *Bull.* 45, edited by McDaniel, A. B., May, 1924.

Act as head of subparty on minor work.

Adjust and make minor repairs to surveying instruments.

Knowledge.—Good command of the English language.

Survey methods on highway location, construction, and maintenance.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, chemistry, physics, surveying, engineering drawing, highway location, design, and construction.

Personal.—Robust physique—able to do exacting instrumental work under adverse conditions of location and weather.

Moderate amount of supervisory ability.

Good eyesight for field work.

Chief of Party

Skill.—Under direction, to supervise and be responsible for the work of a field party in the making of surveys for highway location, contruction, and maintenance.

Make the necessary computations, sketches, and studies for the proper prosecution of the field work.

Make estimates and reports.

Provide for proper organization, subsistence, and transportation of field party, when necessary.

Knowledge.—Good command of the English language.

Care and adjustment of all surveying tools and instruments used by field party.

Field methods of highway location, construction, and maintenance.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, chemistry, physics, geology, field astronomy, engineering drawing, descriptive geometry, surveying, mechanics, hydraulics, and location, construction, and maintenance of highways.

Personal.—Good physical condition and endurance.

Tact, good judgment, and ability in the handling of men.

Inspector

Skill.—Under direction, to inspect materials and workmanship on highway construction, and maintenance.

Make inspections of materials in the pit, at the plant, and on the job.

Make simple field measurements, and tests of materials.

Make the necessary computations, estimates, records, and reports.

Knowledge.—Fair command of the English language.

Properties and uses of the common road and structural materials.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, blue-print reading, and the construction and maintenance of highways.

Personal.—Supervisory ability.

Good physical condition.

Good judgment, tact, and integrity.

Engineer-inspector

Skill.—Under direction, to inspect and oversee assigned portions of highway contruction and maintenance.

Make inspections of materials, machinery, and methods to determine quality and conformity to plans and specifications.

Make the necessary computations, estimates, records, and reports.

Make the required field measurements and tests.

Knowledge.—Good command of the English language.

Use and care of ordinary field instruments for surveying, computing, and testing.

Properties, uses, and costs of road and structural materials.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, chemistry, physics, geology, surveying, engineering drawing, mechanics, hydraulics, theory of structures, structural and concrete design, and construction and maintenance of highways.

Personal.—Supervisory ability.

Good judgment, tact, and integrity.

Good physical condition.

Resident Engineer

Skill.—Under direction, to supervise and be responsible for work of one or more contractors on one or more projects of highway construction or maintenance.

Direct the operation of the field office, including survey party or parties, inspectors, timekeepers, bookkeepers, clerks, stenographers, and other necessary employees.

Make or supervise the making of the necessary designs, computations, estimates, reports, correspondence, and the working out of all problems that come up in the course of the field and office work.

Advise and discuss with public officials, property owners and others, problems relating to highway location, construction, and maintenance.

Knowledge.—Good command of the English language, especially as to oral and written expressions.

Office methods and field systems necessary for operation of field-engineering office.

Methods, materials, machinery, and tools used in highway construction and maintenance.

Economy of highway construction and maintenance.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, chemistry, physics, geology, engineering drawing, descriptive geometry, mechanics, surveying, hydraulics, theory of structures, structural and concrete design, electrical machinery, cost accounting, economics, business law, and highway location, construction, and maintenance.

Personal.—Administrative and supervisory ability.

Tact, patience, and perseverance in human relations.

Good physique and endurance.

Resourcefulness and initiative in handling men, materials, and money.

Copyist, Draftsman or Tracer

Skill.—Under immediate supervision, to make pencil or ink tracings or drawings of plans or maps prepared by others.

Make simple drawings and charts.

Do single stroke and mechanical lettering.

Make simple computations and copy data.

Index and file drawings and field books.

Read and make blue-prints.

Knowledge.—Fair command of the English language.

Use and care of drafting equipment and material.

Conventional signs and symbols used in plan and map work.

Sufficient working knowledge of arithmetic and mechanical drawing to perform the requisite skills.

Personal.—Slight physical disabilities that do not affect use of arms and head allowed.

Drafting bent and capacity.

Good eyesight for close confining work.

Capacity for doing sedentary work of routine nature.

Accurate in making copies of drawings and computations.

Neat in workmanship.

Draftsman

Skill.—Under immediate supervision, to make (revise and ink) maps, plans, working drawings, computations, and estimates required in the preparation of maps and plans for highway engineering projects.

Check, reduce, and plot field notes.

Act as field assistant in survey party.

Make simple field inspections.

Knowledge.—Fair command of the English language.

Office methods as applied to drafting-room.

Use and care of drafting and computing instruments.

Uses of structural and road materials.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, engineering drawing, and mechanics.

Personal.—Aptitude for drafting and computing.

Good memory for figures.

Accurate in making computations and estimates, and in the preparation of drawings.

Capacity for sedentary work.

Highway Designer

Skill.—Under direction, to make computations, estimates, and designs necessary for the construction and maintenance of highways.

Make field examinations and studies necessary for estimates and designs.

Knowledge.—Good command of the English language.

Drafting-room practice.

Economics of highway location, construction, and maintenance, cost keeping, and estimating.

Properties, uses, and costs of road materials.

Field engineering and construction methods used in highway location, construction, and maintenance.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, engineering drawing, physics, chemistry, geology, surveying, mechanics, hydraulics, and location, construction, and maintenance of highways.

Personal.—Aptitude for drafting, computing, and estimating.

Good memory for figures and details of design.

Originality in engineering design.

Accuracy in preparation of computations and estimates.

Office Engineer

Skill.—Under direction, to have responsible charge of an engineering office engaged in the preparation of designs, maps, plans, specifications, estimates, schedules of materials, reports, and permits for highway projects.

Review, check, and be responsible for designs, computations, estimates, specifications, reports, and drawings.

Conduct office correspondence.

Knowledge.—Good command of the English language.

Office methods, including filing, indexing, designing, drafting, estimating, scheduling, blue-printing, bookkeeping, cost keeping, etc.

Personnel methods, material costs, and wage rates.

Survey methods, and construction and maintenance operations on highway projects.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, engineering drawing, descriptive geometry, chemistry, physics, geology, surveying, mechanics, hydraulics, theory of structures, structural and concrete design and location, construction and maintenance of highways.

Personal.—Administrative and supervisory ability.

Tact in handling men.

Good judgment in planning work, making decisions, and reviewing output of office.

Initiative in administering duties of office.

Testing Engineer

Skill.—Under direction, to make, in the laboratory or field, physical test of road and structural materials used in the construction and maintenance of highway projects.

Make the necessary computations, estimates, records, charts, and reports.

Make the necessary measurements, investigations, and inspections.

Knowledge.—Good command of the English language.

Laboratory testing, technique, and methods.

Properties and uses of materials of construction.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, engineering drawing, descriptive geometry, graphical analysis, chemistry, physics, geology, mechanics, electrical machinery, and theory of structures.

Personal.—Aptitude for manipulative and research work.

Observing and accurate in noting phenomena and recording data.

Locating Engineer

Skill.—Under direction, to make preliminary surveys for the location of highways.

Make field investigations to determine natural resources and development possibilities of districts.

Collect and compile data, make reports, and handle correspondence.

When necessary, supervise field survey party.

Knowledge.—Good command of the English language.

Economics of highway location.

Properties and uses of road materials.

Care and adjustment of surveying instruments, especially aneroid barometer, clinometer, and compass.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, chemistry, physics, geology, field astronomy, biology, engineering drawing, descriptive geometry, surveying, mechanics, hydraulics, and location, construction and maintenance of highways.

Personal.—Supervisory ability.

"Eye" for country and "nose" for news.

Good sense of location and direction.

Construction Engineer

Skill.—Under direction, to supervise and direct the construction of highways in a district or division.

Direct, in a general way, the work of one or more resident engineers and their forces engaged on construction.

Act as advisor and arbiter on construction and related problems.

Make, or supervise the making of, the necessary estimates, reports, charts, schedules, etc.

Knowledge.—Good command of the English language.

Construction methods, systems, materials, machinery, and tools.

Economics of highway construction.

Wage rates, labor conditions, purchasing methods, and material costs.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, chemistry, physics, geology, engineering drawing, descriptive geometry, surveying, mechanics, hydraulics, materials of construction, electrical machinery, theory of structures, structural and concrete designs, cost accounting, business law, economics, and highway location and construction.

Personal.—Administrative and supervisory ability.

Good physique and endurance.

Tact and good judgment in handling technical problems and in human relations.

Keenness and accuracy in observations.

Firmness and fairness in decision.

Maintenance Engineer

Skill.—Under direction, to supervise and direct the maintenance of highways in a district or division.

Direct, in a general way, the work of engineers, patrolmen, inspectors, clerks, and others engaged in maintenance work.

Act as advisor and arbiter on maintenance and related problems.

Make, or supervise, the making of, the necessary estimates, schedules, charts, reports, etc.

Knowledge.—Good command of the English language.

Methods, systems, materials, machinery, and tools used in highway maintenance.

Economics of highway operation and maintenance.

Wage rates, labor conditions, purchasing methods, and material costs.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, chemistry, physics, geology, engineering drawing, descriptive geometry, surveying, mechanics, hydraulics, materials of construction, electrical machinery, theory of structures, structural and concrete design, cost accounting, business law, economics, and highway construction and maintenance.

Personal.—Administrative and supervisory ability.

Good physique and endurance.

Tact and good judgment in handling human and technical problems.

Ability to make or supervise the making of analytical studies such as traffic censuses, etc.

Keenness and accuracy in observation.

Firmness and fairness in decision.

Division or District Engineer

Skill.—Under general direction, to supervise and be responsible for the location, construction, inspection, and maintenance of the highway work of a division or district.

Direct the operation of a division or district office, including field and office personnel.

Investigation of highway projects as to adequacy and conformity to requirements.

Review or supervise the review of surveys, plans, specifications, reports, estimates, etc.

Review and approve accounts, contractor's progress, and final estimates, permits, assessments for damages or benefits, etc.

Discuss technical and related problems with, and act as advisor to, contractors and public officials.

Address public and private organizations, committees, and agencies.

Knowledge.—Excellent command of the English language, especially as to oral and written expression.

Engineering office methods and field survey, construction and maintenance systems.

Materials of construction and maintanence, wage rates, labor conditions, transportation facilities, and purchasing methods.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, chemistry, physics, geology, engineering drawing, descriptive geometry, surveying, mechanics, hydraulics, electrical machinery, theory of structure, structural and concrete design, cost accounting, business law, economics, and highway location, construction, and maintenance.

Personal.—Executive, administrative, and supervisory ability.

Tact, fairness, and patience in human relations.

Initiative, resourcefulness, and good judgment in planning and execution of work.

Structural Designer

Skill.—Under direction, to make computations, estimates, and designs for the construction and maintenance of highway structures.

Make field examinations and studies necessary for designs and estimates.

Knowledge.—Good command of the English language.

Drafting-room practice.

Economics of construction, cost keeping, and estimating.

Properties, uses, and costs of structural materials.

Field engineering and construction methods used in structural work.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, calculus, engineering drawing, descriptive geometry, chemistry, physics, geology, mechanics, hydraulics, theory of structures, structural, and concrete design.

Personal.—Aptitude for drafting, computing, and estimating.

Good memory for figures and details of design.

Originality in structural design.

Accuracy in computations and estimates.

Bridge Engineer

Skill.—Under direction, to supervise and be responsible for the design, construction, and maintenance of highway structures.

Make or supervise the making of plans, specifications, estimates, and reports for highway structures.

Inspect or supervise the inspection of the construction and maintenance of highway structures.

Make necessary field investigations and studies.

Knowledge.—Good command of the English language.

Engineering office practice.

Field survey, construction, and maintenance methods relating to highway structures.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, calculus, engineering drawing, descriptive geometry, surveying, chemistry, physics, geology, mechanics, hydraulics, electrical machinery, theory of structures, structural and concrete design.

Personal.—Administrative and supervisory ability.

Tact, good judgment, and patience in human relations.

Initiative and originality in handling technical problems.

CHAPTER XVI

CIVIL SERVICE IN THE HIGHWAY FIELD

Civil service methods of selecting the personnel for governmental positions have been employed in the United States for many years with varying degrees of effectiveness. The federal civil service has been fairly administered and generally effective; that of the states and the municipalities has undergone many vicissitudes because politics and the merit system are generally in opposition.

There will be occasion to refer to political influence as this discussion proceeds, and the term is used in the sense of employing influence to secure patronage to further the political fortunes of an individual or party.

There appears to exist at the present time, a well-founded and deep-rooted prejudice against civil service, even among legislators and public officials of unimpeachable integrity. These fail to realize that not all public officials exert themselves to secure efficiency and that appointments are often made in a hit-or-miss manner; that little or no effort is made to check the efficiency and integrity of employees; and that promotions are largely a matter of chance, whim, or the interposition of interested mutual acquaintances of employees and the promoting authority. These things tend to cause discouragement and lack of aggressiveness among public employees.

Civil Service Ideals.—Civil service is intended as a means of selecting personnel for public service on the basis employed by the better commercial organizations, through examinations, the scrutiny of records of former service, and a study of the antecedents, personal habits, and physical and mental equipment of the applicant. The system seeks to base appointment on the ability of the applicant to serve the public effectively, and promotion on the record of service of men and women who have been under observation. It seeks to regulate compensation in accordance with the value of the service rendered, and to provide an orderly, fair, and adequate system of salary increases based on service. Finally, it

stands between the employee and the directing authority to prevent unjust dismissal or indifferent performance of duty.

Appointment.—Certain state highway departments carry a personnel of upwards of 1,000, many being classed as clerical and unskilled workers. The problem of selecting, training, and classifying such a large number of workers is a tremendous one, and is in itself a highly specialized profession. Civil service affords a means of performing this function with a reasonable degree of certainty and dispatch. Methods of selection are being perfected whereby applicants can be classified according to ability and special fitness and then assigned to lines of work for which they are probably qualified. The employees of a highway department range from those who must be highly skilled in some line of technical work, such as asphalt testing, to those who need no special training beyond a common-school education, or perhaps not even that. Between these extremes are many special classes, such as accountants, draftsmen, filing clerks, stenographers, photographers, technical editors, and scores of other similar classes. Civil service constitutes an independent agency for the impartial selection of the personnel for all of these classes of work.

The appointment of personnel might be made through an employment officer in a department, and quite often is so selected. The two disadvantages of that system are the likelihood of political interference and the absence of expert methods of selection.

Promotion.—The great incentive to ambitious men is the knowledge that promotion can be earned by devotion to the interests of the public and the rendering of consistently good service. A system whereby promotion comes automatically is deadening, and one where promotion comes by favor, demoralizing. Civil service seeks to establish a method whereby promotion can be earned regardless of ability or opportunity to secure the favor of the appointing official. This is accomplished through establishing clearly defined lines of promotion and systematic records of performance. In any such system, the civil service organization must depend to a large extent upon efficiency reports from the employees' immediate superiors, and injustice is possible. Since personnel is sure to change from time to time, records accumulated over a long period are likely to be fair, and in any case there is little probability of systematic

effort being made to do injustice to an employee, and if such an effort were made it would rarely succeed.

Most responsible officials wish to make a good record in their department and to treat subordinates fairly. They prefer to promote worthy men rather than unworthy ones. When they do not succeed, it is generally because of lack of exact information or adverse influences of some sort. The task of checking up on personnel and regulating salaries, promotions, and dismissals would require more time than the busy executive can possibly spare. Civil service is a means of relieving responsible officers from the necessity of acting upon promotions other than as the best public interest dictates.

Compensation.—Rates of pay should be based upon the value of the service rendered by each class of employees as determined by going rates for that class of service in private employment, but should recognize unusual ability and familiarity with the work acquired by long-continued service. It is highly demoralizing when persons performing identical service are paid at different rates, except such as may be justified by differences in term of service. It is equally pernicious for the impression to prevail that a certain salary goes with a certain desk. In a large organization the adjustment of salaries presents a troublesome problem and one that frequently is badly handled because of personalities, lack of time for investigation, and even accidents of daily or occasional contact between the responsible authority and employees. Civil service seeks to equalize salaries among the various classes of service and to provide for regular advancement in salary with an increase in proficiency. When conditions do not warrant increases in salary for a certain class of service beyond a certain recognized maximum, there is provision for transfer to some better-paid class of service for those employees who have been able to prepare for it.

In connection with the establishment of salaries, civil service is a protection to those officials who wish to do the fair thing by their employees but who may be subjected to considerable pressure to favor some of them. Under reasonably favorable conditions the civil service system results in much fairer treatment in the matter of salaries than prevails under other conditions.

Tenure of Service.—Uncertainty of continued employment pervades many public service organizations with the approach

of each election in the political division to which the organization pertains. The employees who have any idea that their position is in jeopardy will be seeking other employment instead of attending to their official duties, or else will be seeking the political favor that will insure them a continued connection with the organization. Those who do not care to do either of these things, or who lack the opportunity to do so, will be in a state of uncertainty and discontent that will continue for months. Meanwhile, the work suffers and the morale of the organization undergoes an almost complete collapse.

The result of the continuation of this condition is that the better class of employees change to positions where they can be sure of continued employment. The turnover is excessive and the efficiency of the organization is affected seriously.

The civil service system seeks to substitute for the idea that the personnel is serving the head of the department, the true conception that it is serving the public. It recognizes that certain positions must be appointive to permit elective officials to secure the adoption of the policies they advocated when seeking office; but it denies that the great mass of subordinate positions are coin for the payment of political obligations. As a nation, there is danger of accepting the theory of political patronage, and the bringing of highway departments into the category of those that provide political jobs will work irreparable injury to the highway transportation of the nation. The state highway departments are often the ones with the heaviest budgets and offer the choicest positions in the state. Politics will absorb and demoralize these departments unless the major portion of the personnel is retained in continued service through an adequate merit system. This is the most important function of the merit system and the one that has caused politicians in general to oppose its operation. Their opposition, of course, is ostensibly based on other and more plausible grounds.

OPERATION OF CIVIL SERVICE

Since there has been set up in the preceding a rather high-minded, and withal difficult, function for the merit system as represented by the conventional civil service organization, it will be in order to note the methods available for performing those functions. It is the common belief that under civil service

the fitness of applicants is determined by examination, which is often the case; but there is little understanding of the scope and variety of these examinations or of the many methods that are followed to secure corroborative evidence as to fitness and training. In theory, the civil service goes about the selection of personnel for public service in much the same way as the private employer. It collects by various means a mass of information in regard to an applicant for a position, and then attempts to evaluate that evidence. Long experience has pointed to certain standard procedure as suited to some classes of employees, and these are followed, so far as possible, in order to facilitate matters; but for special classes of employees, special methods are often devised and followed.

Assembled Examinations.—One method of ascertaining fitness for a position is by means of the ordinary examination. Applicants are assembled at convenient places and subjected to a written or oral examination. No one recognizes the limitations of this method more fully than the experienced civil service examiner. Appointments are seldom based solely on the results of such an examination, but, on the contrary, much additional evidence is obtained. If, however, it is desired to determine whether an applicant can take dictation and transcribe the notes on a typewriter, that can be determined by an examination. Whether the applicant is honest and industrious cannot be determined by an examination. Whether an applicant is a skilled accountant or draftsman can be determined by examination. In general, the assembled examination is suitable for those types of work requiring manual skill and special knowledge of the customary way of performing certain kinds of operations. In some cases the oral examination would be preferable to the written.

Unassembled Examinations.—Unassembled examinations are not examinations in the ordinary meaning of the term. They are conducted by correspondence, and follow very closely the line of investigation a private business would employ in selecting a candidate for an executive position. These examinations usually consist of two parts, the one being the applicant's statement as to his qualifications, and the other of what former employers and associates say about him. In some cases the applicant is required to submit evidence of accomplishment by filing publications, preparing a thesis, or by official documents such as reports or formal publications.

So far as the examination covers the applicant's own statement as to his qualifications, there is a possibility of dishonesty, but when he knows that his statements will be checked up, he is likely to be very careful. Even if he were not truthful, the various forms he will be required to fill out are worded in such a way that there is little probability that he would succeed in deceiving a trained examiner. The applicants are then checked by correspondence with former employers or others who are familiar with their qualifications. It is wholly unlikely that all of the references will perjure themselves in behalf of a candidate, but in any case a private employer must take the same sort of risk in securing information about prospective employees.

The unassembled examination is widely used in securing technical employees of various classes and in the selection of administrative personnel.

Examination Preliminary to Promotion.—It has already been stated that promotion should be controlled by the merit system. Various methods are followed in determining fitness for promotion. First, the record of the service of the candidate is examined, which will include an estimate of his immediate superior as to honesty, diligence, and personality. Perhaps in addition some estimate of fitness for the proposed work will be included. Having established that the applicant has a satisfactory record, it remains to discover whether the applicant is qualified for the new responsibilities. This will be done in one of the ways already discussed for securing information about candidates for a first appointment. Naturally, the examiner will give considerable weight to the information obtained from the responsible officials of the department in which the applicant has been employed, but will not confine the investigation to such information. Generally, the examiner knows when he can depend upon information from a department and when he must seek corroboration.

Dismissal.—No merit system can be effective unless it provides a means of dismissing incompetent employees and every civil service commission has such a provision. The usual arrangement is that employees may be dismissed for just cause or on account of completion of the work for which they were employed; but dismissal for cause must be approved by the civil service organization with the privilege extended to the employee of appearing before the commission to plead his case. The barriers against dismissal of really undesirable employees are more

imaginary than real. On the other hand, wholesale dismissals to make room for favorites are made quite difficult.

ADVANTAGES OF CIVIL SERVICE

The advantages of some merit system, such as the usual civil service, may be summarized in a few paragraphs although they have been mentioned in the foregoing discussion.

Efficiency.—The operation of civil service tends to free the department personnel from political influence in the performance of its usual tasks. In highway construction it is imperative that the plans, specifications, and official documents that comprise construction contracts, be prepared with the single purpose of getting the maximum value for the tax dollar. Personal and political considerations should not enter into any of the technical activities of a department. This ideal can be realized only when employees are independent of adverse political influence in connection with appointment, promotion, or salary scale. Sometimes, this condition exists in a city where no merit system is in effect, but usually it does not exist; wherefore, there is much inferior work done on the streets of our cities.

The state highway departments have been more fortunate in this respect than the cities, and in general there has been little of the spoils politics in state highway administration. There are beginning to be signs of laxness developing, and unless the employment of state highway personnel can be placed on a real merit basis, state highway work will soon be on the same status as municipal work.

Stabilization.—The stability of the policies and practices of highway departments depends upon their being able to secure and retain a competent personnel. This can best be accomplished when employees have an assured tenure of service and congenial working conditions. The merit system tends to insure a reasonable tenure of service, systematic promotion, and orderly increase in salary. It goes a long way in preventing favoritism and the demoralizing effect of undeserved promotion. It may be utilized in fixing individual responsibility and the degree of authority and initiative that accompanies each group of positions.

DISADVANTAGES OF CIVIL SERVICE

The success that attends the operation of a merit system of any kind depends upon the effort made to adapt it to the needs of

the particular departments it is intended to serve. The outstanding problem is to secure good administration of the system itself. This can always be accomplished if the governor, mayor, or other appointing authority so desires; but at best, the system is not perfect since it deals with people and seeks to classify and grade them. Defects are likely to develop, thereby causing irritation and lack of confidence in the system.

Unfairness.—The very foundation of the civil service system is the desire to deal fairly with the employees of the public; but in spite of all precautions, mistakes will be made in rating employees and selecting personnel for specialized kinds of work. This is due to the difficulty of devising methods of measuring human values. A properly administered system will provide a ready means of correcting mistakes of this character, but meanwhile some executive has been disappointed. He will ignore the fact that, if he himself were making selections, similar mistakes would be sure to occur and will have a feeling of impatience with the system.

Inflexibility.—It has sometimes been held that civil service systems are cumbersome and slow and do not provide a ready means of securing employees in a hurry nor a means of readily dismissing those who, for very good reasons, are no longer desired. Neither of these contentions are true of the properly administered civil service system. There is always a provision for the employment of emergency personnel and regulations for the suspension of employees whose connection with the work would be counter to the best interests of the employing departments. Emergency employees are required later to qualify for permanent appointment, and those who have been suspended are given a hearing and permanently dismissed only when the civil service department is convinced that the suspension was for sufficient reason.

In the routine of securing personnel, certain orderly methods must be followed, and these require a reasonable amount of time and deliberation if a careful selection is to be made. It is this precise and careful procedure that is so likely to cause criticism. This part of the system must be accepted and it need cause no inconvenience if the needs of a department are anticipated sufficiently.

Morale.—One of the strongest indictments of the merit system is that it lowers the morale of an organization, suspends

the desire to advance by individual effort, and places a premium upon mediocrity. In short, it is claimed that civil service removes all incentive to individual effort. These things may exist as a tendency under some administrations, but many years of association with employees of the federal government and certain state and municipal governments, all of whom held their positions under a civil service system, has led to the conclusion that there is very little real basis for the dismal forebodings relative to the effect of the merit system on morale. On the contrary, the employees were usually an enthusiastic and contented body of workers who, in ability and devotion to duty, were much superior to those who are employed under a political appointment system. It is conceded that many state highway departments that are not under a civil service system have been able to build up a wonderful *esprit de corps*, but that is because they apply the principles of the merit system in employing and promoting their employees and in the payment of salaries.

Discipline.—The maintenance of discipline is sometimes said to be difficult under civil service, and this probably presents the most troublesome problem of many that may arise. An executive dislikes to make a point of minor infractions of discipline, such as habitual lateness in arriving for work, untidiness, disagreeable personal habits, or minor infractions of office regulations. Some employees will take advantage of that situation to shirk as much as they deem safe; but such employees can be gradually eliminated from an organization.

Individual Opportunity.—It is probably true that the ordinary civil service organization does not provide the maximum opportunity for the individual to make himself felt and for the brilliant man or woman to forge ahead. These will not be contented always under the civil service system. Faithful plodders are carried along with better men in some cases, and even receive promotion ahead of brilliant men because of the priority of longer service. After all, however, the highways of the nation are being constructed and maintained by organizations made up mainly of men and women of the national average in ability and training. For these, some merit system is a protection and a stabilizing influence, but neither reduces nor exaggerates the opportunities for promotion.

Application to Highway Conditions.—A merit system of control of appointments and promotion in the highway field is desirable

for all except a very few specialized classes of employees. It matters very little whether the system is called civil service or is merely a highway department policy, the results will be pronounced and salutory. The exigencies of public service are such that the merit system cannot long prevail unless it is established by law and administered by a centralized body that of itself carries a trained personnel selected for ability and assured of continuity of service and authority.

In the groups that may be classed as unskilled or partly skilled, there will be a large number of clerical employees. These are delegated considerable responsibility in passing upon estimates, accounts, the sufficiency of bonds, of plans and specifications, and in many similar matters of seeming routine. It is very necessary to insure among this personnel a high degree of loyalty to the public interest, which in part can be accomplished by rendering them independent of every outside influence as regards salary, and promotion.

The frequent changes in the administrative boards or commissioner of highway departments in recent years have afforded an opportunity to observe the demoralizing effect on department efficiency. These changes have occurred with increasing frequency in both state and municipal highway departments and have often resulted in many changes in the technical and clerical personnel. The appointment of state highway commissioners and public works directors as a means of satisfying political obligations presents a problem that is discussed elsewhere and is a serious enough matter; but when the same influence results in sweeping changes in personnel throughout the organization, the result is little short of disastrous.

If a merit system is organized in a department, that system can be modified or its acts nullified by the head of the department. So long as the head of the department tries to secure efficiency, the merit system he has set up will aid him. If it were assured that the department head would always use his personnel organization as a means of securing satisfactory working conditions among the employees, there would be no need for a civil service organization.

The temptation, however, to relegate a department merit system into an employment agency is too great and the only sure method of securing an effective and permanent merit system in public service seems to be through the operation of an inde-

pendent civil service commission that is backed by an adequate law.

It is impossible to say just how many of the employees in state and municipal highway departments are now working under a civil service system. There are some ten or twelve states in which the civil service system is in operation. In five states the laws contemplate that all employees of the state government and of all subdivisions thereof shall be under civil service regulation.

About 250 cities have a more or less complete civil service system, and 30 of the more populous counties have established the system for county employees. These cities and counties are in addition to those in the states that have state-wide civil service.

The growth of the civil service system has been very slow, and like any other movement that affects the established order of government is bitterly opposed by some elements of the body politic. The system, nevertheless, is destined to continue its growth and to be a factor in highway administration.

CHAPTER XVII

THE ECONOMICS OF HIGHWAY TRANSPORTATION

The promotion of better roads has been in progress from the very beginning of the Republic and almost every conceivable kind of benefit at one time or another has been claimed for improved highways. It has been recognized in this promotion that the taxpayer is more willing to contribute to those things that add to his pleasure and comfort than to those that may benefit the nation through the production of wealth. Consequently, in the earlier years of the good-roads movement, the social and educational benefits of good roads were stressed by good-roads enthusiasts, while the more pronounced economic benefits received but scant recognition.

In more recent years, the economic considerations involved in the financing of a billion-dollar annual road-construction program have forced official recognition of the economic value of improved highways; but it is doubtful if any considerable portion of the public has as yet a clear conception of the economic considerations that enter into the highway problem. It is not surprising that this is true because the economic benefits are manifested in part through reduced transportation costs, but these are small savings for the individual and will not be detected unless cost records are kept. Few individuals keep costs or know how to do so. Consequently, they have no tangible evidence of the economic value of improved roads.

The excess cost that accrues because of inadequate roads is paid out in driblets from day to day by millions of individuals, and no one of them is occasioned an expenditure that is a burden. The aggregate of these excess costs in the United States scarcely can be computed, but even the most conservative estimate shows it to be a staggering sum. An idea of the magnitude of the total may be gained from the approximate figures that have been used to show the expenditures for automobile operation in the United States in the year 1925. The cost of automobile operation including interest, depreciation, maintenance, and supplies was in the

neighborhood of $9,000,000,000. A reduction of this cost by only 10 per cent would almost pay the highway construction bill for that year, and a greater saving than that could be effected in many states.

Economic Value of Roads.—The economic value of good roads long has been recognized by some of the leaders in highway thought. Nearly 30 years ago Mr. Latta, of the Office of Road Inquiry, United States Department of Agriculture, wrote a circular entitled "Money Value of Good Roads to Farmers." In this publication, the cost reduction to traffic, due to the improvement of the highways, was strongly emphasized.[1]

In his message presented to Congress Dec. 6, 1923, President Coolidge said, "No expenditures of public money contributed so much to the national wealth as for building roads."

The promotion of state bond issues in several states during the year 1923 and later has been based to a large extent on the anticipated savings in the cost of highway transportation that would result from the construction of a state road system.[2]

ECONOMIC THEORY OF HIGHWAY IMPROVEMENT

The public highways constitute one element of a national transportation system, the other element being the vehicles. The highways and the vehicles together afford a facility comparable in usefulness and function to the railways. The railways of the nation consist of a number of systems, each of which is a complete operating entity and is connected with other systems for the interchange of business. Each system, in effect, owns the roadway and the vehicles that operate over it; therefore, the mutual adaptation of vehicle and roadway is a problem of management over which a single group of officials has jurisdiction.

The highway transportation system of the United States consists first of the highways over which the public has an easement for use. These highways are divided into many systems, each under the management of an official body that may develop the roads under its control with little regard for what is done in adjacent jurisdictions. The vehicles are individually owned and operated with all the degrees of skill represented by such diverse ownership.

[1] LATTA, W. C., "Money Value of Good Roads to Farmers," U. S. Department of Agriculture, Office of Road Inquiry, *Cir.* 23, p. 2, 1896.

[2] Especially Iowa, Missouri, and Illinois.

A railway system is operated with a view to showing a profit and within certain limits, dictated by sound public policy, the management may take any steps necessary to insure that the operations are financially successful. Unified management of a whole system including roadbed and equipment, and of all services, such as operation, maintenance, and fiscal transactions, is the only basis upon which a railroad system can be successful.

It is impractical to bring about a similar situation with respect to highway transportation, because the vehicles are individually owned; but the highways of a state may be likened to the lines of one of the railway systems like the Burlington Route. Both have trunk lines and branch or secondary lines; but the main line and all branch lines of the railroad are managed from the same office. The highways are grouped in various ways, there being the United States highways, state trunk highways, county highways, township highways, and municipal streets; and for each group there is a more or less separate and independent system of management. The state highway department may exercise some influence over all the management, but is officially charged with the administration of the main roads only. Correlation of the development of all the roads in a state is wholly impossible at present. It is not too much to hope that this defect will be corrected and that the development of all the highways of a state eventually will be correlated through a state agency. Such a step would go a long way toward securing an economic balance between traffic and types of improvement throughout the nation, and there is an obvious trend in that direction at the present time.

The time is rapidly approaching when highway programs must be based on economic considerations in which cold and uncompromising figures on cost play the leading rôle. The one consideration will be to provide roads that will enable the intelligent and well-informed vehicle owner to secure highway transportation at the minimum cost.

Cost of Transportation.[1] —The true cost of highway transportation consists of two groups of related costs; those that are paid in some form of taxation for road purposes, and those paid by each individual vehicle owner in connection with the use of his automobile, truck, or bus. The aggregate cost of highway

[1] For more detailed data see "Construction of Roads and Pavements," Chap. XVII, McGraw-Hill Book Company, Inc., New York.

transportation in a state or in the United States cannot be estimated with any degree of accuracy, because of a lack of adequate records; but the actual cost of providing certain highways is definitely known, and likewise the cost of vehicle operation on various types of roads is fairly well established. These facts make it possible to estimate the effect of any kind of road improvement on the cost of transportation, but much additional research is necessary before accurate and conclusive transportation cost data can be set up.

The important consideration for any specific road-improvement project is to provide a type of road surface and rates of grade that will furnish highway transportation at the minimum cost.

Road Costs.—The cost of the highway is represented by various direct-tax contributions and certain intangibles that must be introduced to obtain a correct economic basis for discussion. The various tax contributions provide the funds for the construction and maintenance of the several elements of the highway structure and the intangibles in the main consist of depreciation and interest.

The direct-tax contribution toward the construction of a roadway surface is determined by the price paid the contractor for the job. This is the one element of cost that is discernible to the taxpayer. He naturally feels that his interests are being conserved when contracts are awarded at a low price. As a matter of fact, there are many instances when the taxpayers, interest would be best served by awarding a contract for the highest-priced type of construction. This is due to the operation of depreciation and to the importance of the cost of maintenance.

Maintenance cost is readily accepted as a part of the cost of highways and the general experience that low first cost is likely to mean high-maintenance cost seems to be widely appreciated. No matter how excellent the routine maintenance, there will come a time when the cost of keeping the road surface at the maximum serviceability is excessive, and resurfacing or reconstruction becomes advisable. The cost of this operation, or some part of that cost, represents the accumulated depreciation of the road surface.

The road-cost part of the total cost of highway transportation is paid through various forms of taxation, but sums of money that enter into road construction are obviously no longer available

for the use of the various individuals who paid the taxes. These individuals might have invested that money in interest-bearing securities or have employed it in some other way to produce revenue. The various types of roads, moreover, are of varying prices, and to secure a correct comparison of their true cost to the public, this interest must be included as an item of cost. It is a serious mistake to assume that the burden of interest payment is avoided by financing all highway improvement out of current taxes. Sound accounting practice requires the charging of interest for maintenance, as well as constructive costs—a basic economic fact which is just as applicable to current taxes as to bond issues. The argument so frequently heard that interest charges are escaped by refusing to issue bonds is an economic illusion, which often prevents the adoption of a sound plan of highway finance.

Vehicle Costs.—The transportation costs that accrue to the vehicle owner consist of interest, depreciation, maintenance, and operating-cost items in connection with the use of his vehicle. These vary through wide limits for various classes of vehicles and between individual owners of any one type of vehicle. In economic studies, the general average costs for each class of vehicle and for each type of road, is the significant information. These data are available only in fragmentary form, but it has been clearly established that there is a relation between the cost of vehicle operation and the type of road surface. It actually costs less to travel 100 miles on a high-type surface than on an intermediate type, but the amount of the difference in cost is known only approximately.

The portion of the cost of transportation represented by vehicle costs is large, representing on the average at least 90 per cent of the total.

CREATION OF WEALTH

The expenditure of public funds for road construction is justified in part on the ground that wealth is produced by the improvement of highways. Wealth, it will be recalled, may consist of tangible economic goods or of services.

There are several ways in which improved highways produce wealth, most of which revert back to the fact that a highway affords a certain service that is of economic value.

If no highway exists in an area, no development of that area is possible and no economic goods can be produced therein; that is, no wealth will be produced. President Washington and other early statesmen realized this and urged the building of roads into the then undeveloped parts of the territory of the United States.

With crude roads, some development is possible and some economic goods can be produced and marketed. At each stage of road development, there is a corresponding increase in the value of the economic goods that can be produced, until the limit of productive capacity of the land is reached. Beyond that stage, road improvement does not influence the production of economic goods in that area.

It may be taken as a truism that most of the well-administered highway construction programs of the states have created wealth in excess of the expenditure. The converse is that one criterion by which to measure the advisability of any proposed highway project is to ascertain the extent to which it will be likely to produce wealth. To do so, it is necessary to know the ways in which highway improvement produces wealth and the amount of wealth a proposed improvement can actually produce.

Transportation Cost.—Certain kinds of highway improvements produce wealth through lowering the cost of transportation over a route. This lowering is due to decreased fuel consumption, lessened repair costs on vehicles, a lowering of the rate of vehicle depreciation, and the saving of time. The exact amount of the decrease in transportation costs is not determined, but careful investigations indicate that the relative costs on the common types of road surface are about as follows: assuming it costs $1 to travel a certain distance on an ordinary earth road in average condition, it will cost 94 cents to travel the same distance on ordinary gravel as a yearly average, or 87 cents for best gravel, and 80 cents for average paved surfaces such as brick or concrete.

It is apparent that the saving to each vehicle is small, and in order for any highway to produce enough wealth through these savings to justify a capital expenditure of any magnitude, the highway must carry a rather large volume of traffic. The amount of capital that should be invested in any proposed highway improvement, therefore, is dependent upon the traffic that is to be served. While a high-type road has the property of producing

wealth through savings in transportation costs, the saving will not be realized unless traffic actually uses the road.[1]

Property Values.—It has been the rather common belief that road improvement increases the value of land lying near the road. Two factors are involved in the effect of road improvement on land values, and because of them considerable caution ought to be used in estimating the effect of road improvement on land values. The first factor is the capacity of the land to react to the influence of road improvement. No amount of road improvement could give value to the land in the Mojave Desert. Areas of land suitable for truck farming and situated near large centers of population could and would respond to the influence of road improvement. In other areas, the land might respond to the influence of the change from natural soil roads to all-the-year roads, such as provided by the intermediate types of road improvement, but it might not respond further if the roads were changed from an intermediate type to a high type. The nature of the agricultural system, the proximity of markets, and the climate are factors that influence the effect of road improvement on land values; that is, upon the production of wealth by this process.

The second factor is the method of financing the road improvement. If a part of the cost is charged against land in the form of special taxes or special assessments, and the amount so charged is in excess of the actual benefit, then the value of the land may actually be decreased. This is true despite the fact that the particular road project creates wealth through savings in transportation costs.

Several investigators have endeavored to discover the effect of road improvement on land values by researches of various kinds. The results of these studies are inconclusive, although they indicate some of the trends. Probably in no area studied had the latest type of road improvement been in service long enough to make its influence on land values apparent; moreover, land values are affected by so many economic influences that it is difficult to determine the extent to which any trend in land values may have been due to road improvement.

There can be no doubt that considerable time is required for the benefits of road improvement to become effective on land values

[1] Agg, T. R., and Carter, H. S., "Highway Transportation Costs," *Bull.* 69, Iowa Engineering Experiment Station, Ames, Iowa, 1924.

in some areas, while in others the effects are noted immediately. If a new road is laid out through a virgin area or through cut-over timber lands or into a region adapted to recreation, many years will be required for the region to become populated and for facilities to develop to utilize the road. Any estimates of the effect of road improvement on land values, therefore, ought to take the time factor into account.

What is the mysterious process by which wealth is created through an increase in land values? Since wealth consists of economic goods, it follows that an increase in land values indicates an increase in quantity of economic goods that can be produced on the land because of the road service that is provided. Obviously, the productivity of the soil has not been increased through road improvement; but the fertilization of the soil may have been made possible because of better transportation, and the productivity increased thereby. Perhaps the land was not in production because of the impossibility of marketing before roads were improved. Most important of all, perhaps, the proximity of good roads makes it possible to market a type of economic goods of high value, whereas prior to the road development marketing facilities had necessitated the production of economic goods of low value.

Social Influences.—The value of social intercourse in a community cannot be measured in financial terms. That such a value exists is generally recognized, and a prospective purchaser of real estate will inquire about the neighborhood as well as the character of the property.

A satisfactory social environment is so large a factor in the happiness of people, that they are usually more willing to pay for things that make for social opportunity than for things that produce wealth in the purely economic sense. Highway improvements have done an immense amount of good through the promotion of social intercourse and could be of greater service if roads of all-the-year serviceability existed everywhere. This social benefit has been most marked in the rural areas, but has been very important to the cities. No doubt the social effects of good roads have been an influence on the price of land in addition to the direct economic influences of lower transportation costs. Indeed, by making people happier and more contented, thereby enabling them to produce more or better economic goods, the social effect of good roads has indirectly created wealth.

It is impossible to place a money value on happiness and contentment, and so this effect of road improvement cannot be evaluated in economic studies of proposed highway improvements. It can and should be taken into account when funds are being expended, and in many cases will warrant improvements of a more costly type than could be justified on strict economic grounds.

Education.—Those who doubt that education is a factor in the production of wealth will never read these pages, so no thesis will be presented in support of the economic value of education. That good highways are a factor in educational development is perhaps generally known.

The evolution through which the one-room district school is being transformed into the graded consolidated district school is well under way. There is no doubt of the educational value of the new system, but for it to operate at high efficiency there must be regular attendance of pupils and the journey of the pupils must not be too tiresome. If rural schools must be consolidated to give the boys and girls who live on the farms the same educational opportunities that are available to those who live in the towns and cities, good public highways are necessary. There are a number of consolidated rural school districts in areas where earth roads are used in the transportation of school children, and in a great portion of the United States such roads are passable with great difficulty at certain seasons of the year. Good rural schools with a high average of school attendance depend upon improved roads, and in turn improved roads are often the result of a demand for better schools.

It follows logically that educational considerations frequently warrant a relatively larger expenditure of public funds on a given road than would be justified from a purely market or economic standpoint. If school children are to be transported to a consolidated rural school over a public highway, that highway should be surfaced with some material of year-around serviceability; otherwise, there will be a low educational efficiency. There is a growing tendency to take a broad sociological, rather than a cold economic, view of improved roads.

In Spotsylvania County, Pennsylvania, the superintendent of schools reported a very distinct increase in the average attendance where schools were located on improved roads. Table XXVIII shows these facts in detail. It will be observed that

the percentage of attendance in 1913–1914 was 77, as compared with 57 in 1909–1910, an average increase of 38 per cent. Another result of improved roads in that locality was the establishment of a consolidated school at Spotsylvania Court House.[1] Thus, it is apparent that good roads tended to promote increased school attendance and improve the educational facilities generally for the country boys and girls in that county. Other counties included in the survey showed a similar tendency.

An intensive study was made of two counties to determine the relationship between the township and county road systems and the consolidation of rural schools in Iowa.[2] Table XXIX shows the house-to-school travel in consolidated school districts in Buena Vista and Marshall Counties. The details of these tables are self-explanatory. The important point is that 57.6 per cent of the house miles traveled in transporting children to the public school was on the township or secondary road system in Buena Vista County, and 59.3 per cent in Marshall County. The remaining 42.4 per cent of house miles in Buena Vista County, and 40.7 per cent in Marshall County were on the main-traveled roads or county road system. By the term "house miles" is meant the number of miles from a given farmhouse to the consolidated rural school. It will be observed that the average distance to the consolidated rural school was 2.52 miles in Buena Vista County and 2.08 miles in Marshall County. The maximum distance, not shown in the table, was between 5 and 6 miles in each county.

The conclusion is that the township or secondary road, which carries 57.6 per cent of the house miles in Buena Vista County and 59.3 per cent in Marshall County, should be put to grade, properly drained, and given a gravel surface, or the equivalent, in order to promote maximum educational and social efficiency. This suggestion has an important bearing on the distribution of the tax burden for the construction and the maintenance of the public highways. It is certainly a strong argument in favor of a well-balanced road-improvement program, which does not overlook the broad social advantages of at least a part of the secondary road system under the pressure to expend large sums

[1] "Economic Surveys of County Highway Improvement," U. S. Department of Agriculture *Bull.* 393, pp. 27–28, 1916.

[2] Iowa Engineering Experiment Station, Ames, Iowa, *Bull.* 39, "Good Roads and Community Life," p. 23–24, 1917.

of money on the primary roads. From a social as well as an economic standpoint, there is considerable justification for the demand that more of the public funds be expended on secondary roads. This is not a criticism of the program for well-improved trunk roads. The economic value alone of this class of public highways warrants a large expenditure of public funds; but in the enthusiasm for the best type of trunk highways, the status of the secondary roads must not be lost to sight.

Summary.—The determination of the advisability of any program of highway improvement involves an analysis of the economic, social, and educational influences that will be exerted by the improvement.

The economic consideration is the capacity of the proposed improvement to produce wealth commensurate with the required capital expenditures. This is determined by an analysis of the traffic that will use the road and the relation between the type of road surface and the cost of transportation thereon. Fixed rules are available for doing this. The educational and social influences must be evaluated with liberality and vision, since fixed rules do not exist.

REGULATION OF TRAFFIC

The need for comprehensive regulation of traffic has grown with the development of the motor vehicle. In the days of horse-drawn traffic, there were simple rules of the road, and in the cities there were some regulations relative to types of vehicle and weight. Motor traffic has necessitated much more rigid regulations than were previously needed. Hence, there has grown up in each state and city a set of laws and administrative regulations dealing with the control of traffic. Unfortunately, there is little uniformity in these, and the vehicle driver is sometimes a good deal at loss when he reaches a region with which he is unfamiliar. There has for several years been a concerted effort to secure uniform regulations relative to traffic throughout the United States, and some progress is being made in that direction.

Regulation of traffic is usually entrusted to law-enforcement officers and hence does not enter into the administrative work of the highway departments. These departments, however, are concerned with those regulations that are intended to protect the highway or that affect the design of the highway.

Load Regulations.—Each roadway surface has a safe load limit. If subjected to loads in excess of the safe one, eventual failure is inevitable, although the first of such loads may not cause it. To safeguard the investment in the road, load regulations are established, and in the course of time all roads subject to the maximum load will be strengthened to the point where their safe load limit coincides with the legal load limit.

If load regulations are not alike in adjoining states complications result; which is one argument for uniform traffic regulations. Since the high-type road surfaces may be expected to have a life of 20 years or more and can be strengthened only at considerable expense, load regulations once established must stand for a long time.

The enforcement of load limitations has been lax in most of the states, but of late a tendency to strict enforcement is noted, no doubt due to evidences of road failure because of overloads. Portable scales are used to check the weight of vehicle and load, and, if overloading is encountered, punitive action is taken. In some states the highway officials have been compelled to take the initiative in detecting overloading to forestall serious damage to the highways.

In addition to the maximum-load provisions applicable to high-type road surfaces, it has been found desirable to enact laws permitting temporary load limitation whereby the intermediate-type roads can be protected during any period when the load capacity is reduced by weather conditions. This is usually accomplished by authorizing the responsible public board to take appropriate action at any time, giving due public notice thereof.

The cities have been very slow to adopt load regulations applicable to vehicles using the pavements of the city. Overloading is probably more common in the cities than on rural highways, and pavements have suffered accordingly. Lack of power of regulation in some cases and lack of appreciation of the need of regulation in other cases have been responsible for the failure to act.

Vehicle-size Regulations.—A vehicle of abnormal dimensions can cause a great deal of confusion on highways that are carrying a big volume of traffic. The highway engineer must know the size of the units of traffic to be accommodated before he can design the structures. Certain elements of the highway are of definitely limited-size capacity, especially bridges and subways.

General regulations have been established as to width and length of vehicle, which are enforced largely through the cooperation of the manufacturers of vehicles.

Speed Regulations.—The engineer is interested in regulations of speed only to the extent that such regulations may influence design. Sight distance and the amount of superelevation on horizontal curves are usually based on the legal speed limit when it is possible to do so. Speed regulations are difficult to enforce and are probably wrong in principle; hence, design is often developed with little regard to existing speed limits and dependence placed on warning signs to indicate safe speeds.

COMMON-CARRIER REGULATION

The growth of highway transport by common carriers has introduced a number of problems in regulation, and these are likely to increase in importance and difficulty as time passes. The states can regulate intrastate traffic only, and yet the interstate business of the highway transport companies is of sufficient volume to have caused the Interstate Commerce Commission to interest itself in some cases that have arisen. The conflict between the Interstate Commerce Commission and the state railroad commissions over certain phases of railway regulation is scarcely settled, and now a similar situation is arising in reference to highway transportation.

There is at present practically no federal legislation with reference to the regulation of interstate highway traffic, and the whole field remains to be developed.

State Regulation. The states can prescribe the process by which authority may be obtained to operate as a common carrier on the highways of the state, and the compensation that shall be paid for the use of the highways of the state. It may also supervise rates and service, within certain broad limits. These functions are generally exercised by the state railroad commission or utility commission, enabling legislation prescribing the powers and duties of the board in such matters.

The only phase of state regulation that is of particular interest to highway officials is that which fixes the compensation exacted for the use of the public highways. This ranges in various states from $50 per year for a bus or light truck to about $1,200 per year for busses and trucks. No one seems to know what is the

proper basis for this charge, and it will be several years before any stable or uniform policy can be formulated.

Highway officials seem to feel that the highway common carrier must contribute to road funds in proportion to highway costs that accrue because of common-carrier vehicles. If this class of traffic does not pay its way on the roads, then it is subsidized by the public to the extent that the common-carrier taxes fail to meet the road expense caused by this traffic. To require it to contribute more is unfair to a necessary business.

The problem is one of estimating the amount of road cost that is due to busses and trucks used for common-carrier business, and at present there are no adequate data on the subject. It is believed that a fair rate of taxation for common carriers must take into account three factors as follows: the weight and type of vehicle and its tire equipment, the speed, and the mileage of travel. A rate per ton-mile of travel could be fixed for each class of vehicles, taking into account the three essential factors. Where the travel is over fixed routes on regular schedules, this system is feasible. It is not so readily applied to intermittent service, but perhaps some type of odometer could be used to secure the mileage of travel.

It appears to be eminently fair that the proceeds of taxation on vehicles used for common-carrier service should be devoted to highway purposes, except for the portion needed to cover the cost of collection. The funds devoted to road purposes should certainly go toward the upkeep of the roads used by the common-carrier vehicles, but in some states the trunk highways are so generally used by busses and trucks that the vehicle taxes might as well be added to the maintenance funds for the trunk highways without reference to special routes.

TRAFFIC

All of the benefits derived from road improvement arise out of the great direct and primary benefit which is experienced by the users of highways—benefits to traffic. The one main purpose of all highway improvement is to facilitate transportation, and all other functions and benefits are incidental to those derived by traffic. It follows, then, that all problems of highway finance and administration are inseparably linked with highway traffic. Roads that are used but little can confer but minor benefits regardless of the magnitude of expenditures thereon. Roads

with dense traffic can confer benefits of astonishing money value if the improvements are of the right kind.

Function of Traffic Survey.—Shall a certain highway be surfaced with gravel, or concrete, or brick? How expensive should the foundation be, how much reinforcing should be used, how thick the concrete? It is recognized that a road which gives very satisfactory service under a certain density and quality of traffic will soon fail when the traffic is doubled or heavy motor trucks begin to use it. Many a road that was properly graded, drained, and provided with a road surface capable of withstanding for an indefinite period the traffic for which it was designed has been destroyed under the heavy motor-truck traffic of a great industrial center like Chicago or Detroit.

How much money should be expended for a proposed road improvement? How should these funds be secured? To what extent should road funds be provided by local township taxes, county taxes, motor-vehicle taxes, and state or national aid? What percentages of the traffic is interstate or national in character? What percentage of traffic crosses county lines in a state highway system? What portion of the traffic is strictly rural in character, plying between the farm and local market, and what percentage has no direct connection with farm needs? These questions and many others must be answered before it is possible to formulate any scientific plan of highway finance and administration. The proper distribution of national, state, and local highway funds cannot be made without definite knowledge along these lines.

How is it known whether farm lands, through the general property tax are bearing more or less than their just share of the highway tax burden? Should the amount of revenue obtained from motor vehicles in one form or another, or through state or national aid be increased or decreased? What power should a state highway commission have in the administration of highway funds, not only on primary roads but on secondary roads as well? The answer to all of these questions and many others like them is to be found in the information obtained by the scientific traffic survey.

The voting of highway bonds, the levy of taxes for highway purposes, proper plans both of maintenance and construction, the most efficient systems of highway administration, and a large number of other matters of fundamental importance to the good-

roads movement should be based as much as possible on definite knowledge obtained through traffic surveys. The traffic survey, as that term is now understood, coupled with a scientific study of the earning capacity of different types of improved roads, is rapidly taking the guesswork out of highway construction and maintenance and is placing that very important public service on a business basis. The traffic survey should produce two kinds of data as indicated in the following tabulation:[1]

1. Highway administration and engineering data:
   1. To determine daily, seasonal, and yearly traffic density and distribution on state highway systems.
   2. To estimate future traffic on state highway systems.
   3. To determine the relation of traffic density to the factors responsible for the growth of traffic, such as motor-vehicle registration, production, and population.
   4. To classify highways as industrial, high-, medium-, or low-type traffic routes, and determine design requirements based on (1) passenger-car and motor-truck density and (2) motor-truck capacities, gross loads and prevailing wheel loads.
   5. To determine highway width in proportion to traffic.
   6. To estimate the extent to which the improvement of old, or the opening of new traffic routes is economically justified.
   7. To correlate traffic loads and density on the highways with highway construction and maintenance costs.
   8. To determine the type and volume of traffic on the highways as an index to the allocation of highway construction and maintenance funds.
   9. To determine the amount and frequency of motor-truck overloading.
   10. To compare the cost of various types of highway improvements, such as relocations, grade reductions, elimination of grade crossings (both rail and highway), traffic, "bottle necks," with the estimated saving in transportation costs resulting from such improvements.
   11. To compare the earning value of the state highway system (based on passenger-miles and freight ton-miles) with the present worth of the highway system using replacement value minus depreciation as the basis of computing present worth.
2. Highway economic data:
   1. To obtain highway transportation information concerning the volume of tonnage shipped by motor truck and the relation of highway transportation to the other types of transportation.
   2. To determine the mileage zones of motor-truck haulage.

[1] "Highway Transportation," by McKay, J. G. in *American Highways*, vol. 4, 1, pp. 34–40, January, 1925.

3. To determine the situs of ownership of passenger cars and motor trucks operating over the highway systems.

4. To estimate the value of motor-truck net tonnage hauled over the highway systems.

5. To determine the type of origin and destination as well as the origin and destination of net tonnage of commodities transported by motor truck over the highway systems.

6. To estimate passenger-car business and non-business usage of highways.

7. To determine the proportion of farm traffic on the highways.

CONCLUSION

The economic theory of highway improvement is not yet fully established, and many researches will have to be carried out before information is available upon which to base definite conclusions.

It is known that highway improvement may produce wealth, and the exact amount of wealth that can be produced under any set of conditions can be determined with reasonable accuracy.

It is recognized that vehicle taxes should pay a part of the cost of road improvement, and for any specific road an equitable distribution of cost between vehicle taxes, general property taxes and special taxes can be computed on a scientific basis.

There is ample evidence that there should be some correlation of the improvements of all classes of roads in a state, and the only agency that seems competent to do that is the state highway department. How can a unified system of administration, however, be developed without doing violence to the traditional local-government sentiment of the nation? That remains to be determined.

Regulation of traffic is a recognized necessity. Public safety, prevention of crime, protection of the roads, and taxation for revenue are all involved. Traffic is both intrastate and interstate, and this indicates that regulation will be by each state and by the federal government. What system can be developed that is fair and effective?

All these problems have arisen within a generation, and doubtless a decade or more will be required to work out solutions for them. Meanwhile, it is impossible to do more herein than to point out the basic considerations involved in these developments and the trend of official opinion and of legislation, so far as they can be determined at this time.

INDEX

A

Accounting, 292, 301
Act of 1902, Iowa, 32
Act of 1925, Iowa, 35
Adams, Professor, 116
Administration, bond issues, 193
  county, 56, 75
  evolution of, 252
  highway, development of, 51
  highway finance, 170
  national highway, 1
  rural highways, 51
  state and local, 28
  state highway department, 57
  township, 55
Administrative duties, highway engineering, 331
  problems, 60
  regulations, federal aid, 143
Alexander Hamilton, 1
Amendments, federal aid, 141, 145
American Association of State Highway officials, 70, 168
Analysis, project, 266
  road expenditures, 184
Appalachians, the, 4
Apportioning costs, 171
Apportionment, federal aid, 139
  special assessments, 209
Appropriation of 1893, 26
Appropriations, Cumberland road, 7, 8
  Federal aid, 144
  Federal government for roads, 22
Arbitration, 245
Area rule, special assessments, 212
Asphalt pavement inspection, 229
Assembled examinations civil service, 351
Assessed values, 210
Assessment districts, 205, 217, 219
  methods of, 195, 196, 210
  practice, 214, 215
Authority for expenditures, 303

B

Bassett, 214
Bastable, 160
Belgium, special assessments in, 196
Benefit factor method, 213
Benefits, extent of, 209
  of federal aid, 148
  to definite groups, 171
  to property served, 171
  to road user, 171
Berkeley, 163
Betterment tax, 207
Bond expenditures, California, 186
Bond issues, 179, 193
  administration of, 193
  control of, 191, 192
Bonds, 115, 179, 180, 186, 191, 192, 193
Bonds, serial, 179
Bonne, Daniel, 30
Bonus bill, 13, 15
Braddock, general, 3, 4
Braddock's road, 5
Bridge and culvert inspection, 231
Bridge Engineer, qualifications for, 346
Bridges and culverts, 224
Bureau of public roads, 26, 27, 70, 71, 72
Bureaucracy, 55
Business taxes, 115

C

Calhoun, John C., 5, 15
California, analysis of road expenditures, 184

California, experience of, 190
highway advisory committee, 181
highway bonds of, 180
road expenditures, 183
road systems, 182
state and county road expenditures, 185
typical bond issue, 187
Canada, highway system, 88
Canadian highways act, 89
Chainmen, specifications for, 338
Chief of party, specifications for, 339
China, highway system, 104
National Highway Commission, 105
regulation of highway improvements, 104
Civil service, advantages of, 353
appointments, 348
assembled examinations, 351
compensation, 349
disadvantages of, 353
discipline of, 354
dismissal, 352
efficiency of, 353
highway field, 347
ideals, 347
individual opportunity, 355
morale, 354
operation of, 350
promotion, 348
stabilization of, 353
tenure of service, 349
unassembled examinations, 351
Classification of federal aid roads, 149
Classified property tax, 112
Clay, Henry, 5, 7, 15
Codes, law, 242
Coleman & Rusk, ideas of, 26
Confederation, articles of, 1, 2
Consolidated school districts, 366
Constitution, the, 1
Constitutionality, 12
Construction engineer, qualifications, 344
Construction methods, reports on, 326
Construction operations, 289
Construction, supervision, 320
time of, 276
Constructor, 265
Contract practice, 330
Contract system, 311
disadvantages of, 312
inspection, 311
investment, 311
prices, 311
risks, 311
Contract work, 265
Controlling expenditures, 303
Cooke, J., 163
Cooley, 202
Correlation of inspection, 231
Cost keeping, 292
County administration, 56
origin of, 75
County highways, 87
County, the, 45
Cumberland Gap, 30
Cumberland road, 3, 4, 13, 138
abandonment of, 19
appropriations for, 7, 8
constitutionality of, 12
cost of, 11
first contract on, 7
money advances for, 5
origin of, 5
politics of, 17
road fund, 5
specifications for, 10
tolls on, 11, 12
west of Ohio, 9
Current funds, 165
Czechoslovakia, highway system of, 102

D

Day labor construction, 306, 308, 309, 310
advantages of, 309
control of, 309
cost of, 309
disadvantages of, 310
Dayton View Park, 219
Denmark, highway systems of, 100

Design, highways, 233, 323
Detroit, 219
Dickens, Charles, 23
Dinwiddie, Governor, 3
Distribution of costs, 170
Distribution of tax burden, 119
District engineers, 233, 245
Districts, special assessment, 217
Division engineers, qualifications for, 345
Divisions, bureau of public roads, 71, 72
Dodge, Mr., 133
Draftsmen, qualifications for, 341

E

Economic problems, 335
Economic theory, highway improvements, 359
Economic value of roads, 359
Economics of highway transportation, 358
Education, 365
Efficiency studies, 333
Eminent domain, 200
Employees, classes of, 315
Engineers, highway, qualifications for, 338
  inspector, qualifications for, 340
England, highway systems, 90
  road board, 93
  special assessments in, 195
Estimate sheet, Illinois, 287
Estimates, 285, 286
  of costs, 288
Evolution of administration, 252
Expenditures, 130, 131
  authority for, 303
  control of, 303
  for field work, 303
  for surveys, 303
  road, 118, 120, 121, 122, 123

F

Faculty, special assessments, 206
Failures, reports on, 325
Fairlie, Professor, 46
Federal act of 1806, 5
Federal aid, 128, 133, 138, 139, 141, 145
  act of 1912, 133
  administrative regulations, 143
  allotted, 153
  amendments, 1919, 141
  amendments, 1921, 145
  apportionment of, 139
  appropriations, 144
  benefits of, 148
  highway construction status in 1926, 156
  highways, 67
  laws, new provisions, 145
  mileage, total cost, etc., 152, 153
  post war efforts, 141
  progress of, 140
  roads, classification of, 149
  roads, location of, 144
  roads, maintenance of, 146
  roads, research on, 147
  roads, statistical data, 150
  roads, types of, 147
  roads by types of construction, 154
  securing of, 72
Federal appropriations for roads, 22
Federal Bureau of Public Roads, 70
Federal revenue from motor vehicles, 118
Fees, revenues from, 110
Field personnel, instructions to, 317
Field work, expenditures for, 303
Financial analysis, road program, 250
Financial problems, 334
Florida highway organization, 63
Forest road projects, 144
Forest roads, national, 137, 139, 144
Forest roads, system of, 150
Formal instructions, paper work and reports, 314, 323, 324, 325
France, highway system of, 96
  special assessments in, 196
Freight routes, 81
French, 37
Front foot rule, special assessments, 211
Fuller-Plank act, 39, 40

G

Gallatin, Albert, 5, 14
General instructions, 316, 320
Giles, Wm. B., 5
Glover, Professor, 190
Grading inspection, 228
Gravel surfacing inspection, 228
Guide signs, 85

H

Hamilton, Alexander, 1
Henry VIII, 196
Hewes, L. I., 190
Higbie-Armstrong act, 39
Highway administration, 1, 28, 51, 64, 170
  development of, 51
  history of, 1
  ideal systems, 64
  rural, 51
  state and local, 28
Highway bonds, 160, 164, 172, 178, 180
  California, 180
  history of, 172
  Illinois, 178
  New Jersey, 173
  New York, 173
  rural road and bridge purposes, 176
Highway departments, provincial, 90
  technical functions of, 222
Highway design, 223, 323
  designer, 342
Highway engineering, field of, 328
  positions, 338
Highway finance, 41, 108, 169
  principles of, 108
  state and local, 41
Highway improvements, 165
  economic theory of, 359
Highway location, 222, 318, 319
Highway organization, types of, 65
  Florida, 63
  New York, 66, 67
  Texas, 67, 69
  Vermont, 65, 67
Highway studies, 42
Highway systems, development of, 74
  future, 86
  outside U. S., 88, 104
  rise of, 77
  state and national, 83
  Switzerland, 101
Highway transportation, economics of, 358
Highways, county, 86
  federal aid, 67, 144, 146, 147, 149, 150, 154
  new, 86
  secondary, 87
  state, 68
  state aid, 69
  total costs of, 171
  township, 87
  U. S., 83, 149
Historical forces, 36
House organs, 327
Houston's recommendations (1913), 135
Hurlburt, 8, 14

I

Illinois, estimate sheet, 287
  highway bonds, 178
Improvements, promotion of, 246
Income all road purposes (1921), 126, 127
Income tax, 114
Inheritance tax, 115
Inspection, asphalt pavement, 229
  bridge and culvert, 231
  contract, 311
  correlation of, 231
  grading of, 228
  gravel surfacing, 228
  materials, 225, 320
  municipal construction, 257
Inspectors, qualifications for, 339
  types of, 232
Instrumentman, qualifications for, 338
Iowa, act of 1902, 32
  act of 1925, 35

Iowa, federal aid road fund, 35
good roads movement, 32
highway commission, creation of, 33
highway commission, powers of, 33
law of 1913, 33, 49
road patrol, 34

J

Jackson's veto, 17
Jefferson, Thomas, 14
Job organization, 281
Johnson, Thomas, 3

L

Lancaster turnpike, 4
Land grants for roads, 22
for road subsidies, 23
Law codes, 242
Law of 1913 (Iowa), 33, 49
1925 (Iowa), 35
1893 (Massachusetts), 38
1891 (New Jersey), 38
Laws of Maryland, 29
Virginia, 29
Legislative trends, 51
Levies, road, 118, 124, 203
Limitations, tax and debt, 205
Load regulation, 369
Location engineer, qualifications, 343
Location, highways, 222, 318, 319
London, 196
Lutz, 162

M

MacDonald, Thomas H., 149, 167
Madison, President, 5, 12, 14, 15
Maintenance engineer, qualifications for, 344
Maintenance, federal air roads, 146
Maintenance, municipal construction, 258
Management, problems of, 316
Manuals, 241
Marshall's Doctrine, 13
Maryland, road laws of, 29
Massachusetts, law of 1893, 38
Materials inspection, 225, 320
testing, 225
Maybury, Sir Henry P., 90
Mechanical equipment, 307
Melon, 163
Mileages, road, 120, 121, 122, 123, 124, 129
Modern highway systems, rise of, 77
Monroe, President, 5, 14, 16
Morton, Governor, 39
Motivation, 314
Motor vehicle taxes, 116, 171
nature of, 116
Motor vehicles, federal revenue from, 118
Municipal construction, inspection, 257
maintenance, 258
organization, 259
research, 259
testing, 258
traffic regulations, 259
Municipal engineering, 255
Municipal highway departments, 251
Municipal improvements, initiation of, 262

N

National defense, 81
National forest roads, 137, 139, 144
National highway administration, history of, 1
National highway commission, 143
National highway system, improvement of, 83
National roads, 76
New Jersey, law of 1891, 38
New York, highway organization, 66, 67
special assessments, 196
state aid law, 39
tax distribution, 134
North Dakota, tax distribution, 119, 129
Norway, highway system of, 98

O

Office engineer, qualifications for, 342
Office of road inquiry, 27
Operation analysis, 268
Ordinance books, 242
Ordinary revenues, 128
Organization, county and township, 43
Organization, job, 281
  municipal construction, 259
  National highway commission, China, 105
  state highway, 63, 65, 66, 67, 69
Ormond, 20

P

Page (1914), 41
Pavement problems, 252
Pennybacker, 41
Personal relationships, 336
Philadelphia and Lancaster turnpikes, 4
Pinto, 163
Plank roads, 25
Police power, 199
Political balance, 44
Politics, 253
  Cumberland road, 17
Poll tax, 115
Popular control, bond issues, 192
Potomac company, 3
Professional enthusiasm, 337
Progress diagrams, 272, 273, 274, 275, 277, 278
Progressivity, 207
Project analysis, 266
Promotion of improvements, 246
Property taxes, 111
Property values, 364
Proportionality, 206
Provincial highway department, Canada, 90
Prussia, special assessments in, 196
Public debts, 160
Public domain, revenues from, 109
Public finance, 108
Public Health Act, 1872, 92
Public relationships, 337
Public revenues, classification of, 109
Public road mileage and expenditures in United States in 1904, 120, 123
Publicity problems, 235

Q

Qualifications for highway engineering positions, 338
  superintendents, 282

R

Recreation areas, 81
Regulations, highway improvements, China, 104
  load, 369
  traffic, 368
Relocations, minor, 85
Reports, 314, 323, 324, 325
  on construction methods, 326
  failures, 325
  preliminary, 325
  research, 326
Research, 72, 167, 227, 259, 326
Resident engineers, 322, 340
Responsibility of subordinates, 64
Revenues from fees, 110
  from miscellaneous sources, 111
  from public domain, 109
  from public industries, 109
  from special assessments, 111
  public, 109
  road, 118
Richardson, 36
Road board, England, 93
Road connections adjoining states, 80
Road costs, 361
Road expenditures, 118 to 123 inclusive.
Road inquiry, office of, 27
Road laws, Iowa, 32, 33, 35, 49
  Maryland, 29
  Virginia, 29
Road levies, 124

Road location, 144, 222, 318, 319
Road mileages, 120, 124, 125, 129
Road mileages, income, etc. for 1921, 1914, 1909 and 1904, 125
Road patrol, Iowa, 34
Road revenues, 118
Road subsidies, land grants for, 23
Road system, California, 182
Road systems, state, 79
Roads, economic value of, 359
  Federal aid, 144, 146, 147
  forest, 144, 150
  land grants for, 22
  local control, 23
  national, 76
  national importance of, 80
  plank, 25
  toll, 75
  U. S., 149
  wilderness, 30
Rodmen, qualifications for, 338
Rosewater, 203
Route and guide signs, 85

S

Salaries, 303
School attendance, 366
  consolidated districts, 366
Secondary highways, 86
Seligman, Professor, 202
Serial bonds, 179
Shirras, 161
Social influences, 365
Social problems, 335
Special assessment districts, 217, 219
Special assessments, 111, 195, 199, 202, 208, 209
  apportionment of, 209
  Belgium, 196
  England, 195
  fiscal status of, 202, 209
  France, 196
  legal basis of, 199
  New York, 196
  Prussia, 196
Special benefits, theory of, 203
Special taxes, 203
Specification writing, 240
Specifications, contents of, 238
  Cumberland road, 10
  department standards, 234, 242
  highway engineering positions, 338
  influence of, 236, 237
  national society, 242
  preparation of, 234
  purpose of, 236
  special, 235
  state road systems, 79
  trade association, 243, 244
Speed regulations, 369
Standard plans, 224
State aid, 35, 41, 132
  forms of, 41
  highways, 69
  laws, 35
  laws New York, 39
  laws other states, 39
  laws Vermont, 39
State and local highway administration, 28
State and local national highway systems, 83
  improvement of, 83
State highway commission, Iowa, 33
State highway departments, administration, 57
  continuity of policy, 61
  efficiency of organization, 61
  functions of, 59
  theory of organization, 62
State highway organizations, types of, 65
State management, origin of, 76
State regulation, 370
State road system, preliminary, final, 82
  selection of, 81
  specifications for, 79
Statistical data, federal aid roads, 150
Stockton, Lucius W., 9
Story County, Iowa, 203
Structural designer, qualifications for, 346
Superintendence, day labor construction, 306

Superintendents, qualifications for, 282
Supervision, construction, 320
Surveys, expenditures for, 303
Switzerland, highway system, 101

T

Tax, betterment, 207
Tax burden, distribution of, 119
Tax distribution, New York, 119
  North Dakota, 119, 129
Tax limitations, 191, 205
Taxation for roads, 37
Taxes, bond, 115
  income, 114
  inheritance, 115
  motor vehicle, 116, 171
  poll, 115
  property, 111
  road, 118
  special, 203
Taxing power, 201
Testing engineer, qualifications, 342
Texas highway department, 67, 69
Time studies, 291
Toll roads, 36, 75
Tolls, Cumberland road, 11, 12
Township administration, 55
Township highways, 87
Townships and cities, 47
Traffic problems, 252
  regulations, municipal construction, 259
  surveys, 166
  surveys, function of, 372
Transportation, cost of, 360, 363
Turnpike, Cumberland, 3
  Philadelphia, 3
Turnpikes, 3, 4

U

Unequal taxation for roads, 37
United States highways, 83, 149

V

Vehicle costs, 362
Vehicle size regulations, 369
Vermont, highway organization, 65, 67
Vermont, state aid laws, 39
Veto, Jackson's, 17
  Madison, 15
  Monroe, 16
Virginia, road laws of, 29

W

War revenue act 1917, 117
Washington, ideas of, 2, 3
Wealth production, 163, 179
Wilderness road, 30

Y

Young, 8, 13

Z

Zane's trace, 5
Zone area method, assessment, 212

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